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AGRICULTURAL ENGINEERING

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Technology Reaches Congress

FIRST legislative fruit bud stimulated by the National Resources Committee report, "Technological Trends and National Policy," showed up in the last session of Congress, shortly after the report was off the press, as HR7939.

Entitled "A Bill to provide for the promotion of the general welfare in relation to the economic effects flowing from scientific and technological developments," the measure was introduced by Representative Jennings Randolph of West Virginia in a bold challenge to reactionary views.

It upholds science and technology as essentially good, and as prime agencies of human progress. In this it registers what scientists and engineers have consistently contended throughout the depression and since long before. It proposes definitely increased governmental sponsorship of scientific and technological progress in the public interest.

The only point on which scientists and engineers might disagree among themselves as to the wisdom of the measure, is the proposed organization and operation setup. It sounds complicated. Perhaps it would have to be to serve its purpose. The organic setup involves specifically the existing Departments of Labor, Commerce, and Agriculture, the National Resources Board, Civil Service, National Academy of Sciences, and American Arbitration Association. In addition it provides for new technical bureaus or divisions in three departments to advise a Cabinet Advisory Committee on what advice to give to a Scientific Research Commission, which is to be further assisted by an independent committee, and by legal and technical consultants, in addition to numerous civil service employees and subsidized research workers. The Commission would finally report to Congress and, in turn, receive its appropriations therefrom.

Rough points in the plan can be smoothed out later, if necessary. The important fact is that science and technology have been submitted to Congress, by a Congressman, at their face value as forces in American civilization, with a proposal that they be utilized as national forces for the national welfare, to increase the volume of possible and desirable employment, production, and consumption. Congressional interest in causes and effects, as compared to mere political expedients, is a healthy sign.

Analysis of Electric Uses

HAVING strongly urged application of engineering analysis to agriculture, Dr. E. A. White has proceeded, on an experimental basis, to make an engineering analysis of electrical uses on certain farms and groups of farms. The results are now published in a paper by him and J. P. Schaenzer, presented to the fourteenth annual meeting of the Committee on the Relation of Electricity to Agriculture, held in Chicago last month.

Purposes of this preliminary analysis were to find out what advantages farmers believe electric service offers them; what changes in living conditions and agricultural practices are likely to follow increased use of electric service; and what engineering units might be used to accurately and concisely indicate use and performance of electricity and electric equipment in various agricultural applications. Most of the data obtained are from farms on three primarily rural distribution lines in Wisconsin.

As to the first purpose, it was found that "the majority of these farmers still look upon electric service primarily as a step to improve living conditions. . . . Approximately 90 per cent of the connected load on these farms was for household uses, lighting, and water pumping."

Changes in living conditions and agricultural practices likely to follow increased use of electric service were indicated by comparison of average use with the extensive use found on exceptional farms. Predominance of 25-watt bulbs over larger sizes suggests opportunity for more light on the subject of lighting. Continued progress toward optimum lighting is a reasonable expectation. The well-electrified farms used not only larger light bulbs and more of them, but more heating devices and more motor-operated devices, both in the home and in farm production operations. One farmer obtained an unusually high load factor on a connected load of 8.8 kw. Some farmers used electricity to enable them to render increased service in processing their products and protecting quality for the consumers.

In connection with progressive electrification, it is significant to note that the rate of increase in use of current and new devices by the individual families leveled off characteristically after about five years. This slowing-down point was found to be much more uniform as to the time element than as to any specific degree or standard of electrification achieved. This suggests the influence of other factors.

The horsepower was used experimentally as a unit for measure and comparison of all farm heat, light, and power uses. Farms having an average of 57 non-electric primary horsepower outside of the house and 32 non-electric primary horsepower for household use, were found to have an average of 6 primary horsepower available in electric equipment. A large fruit farm, well electrified by present standards, with 116 electrical horsepower and 124 additional horsepower, used 404 man-hours of labor per year per primary horsepower, in a heavy crop year, and 213 in a light crop year. The primary horsepower is apparently a significant unit. Kilowatts were useful in comparisons of connected load; energy use groups; current-consumption per year per equipment dollar, per year per person, per year per acre, and per year per family.

Such is the beginning of engineering analysis of agriculture. It reveals the opportunity awaiting agricultural engineers for "developing factors, units, and other engineering information which will indicate the better practices. measure progress, and clearly point the direction of change," not only in rural electrification but in all farm needs and applications of power, equipment, and materials.

Farm Crop Utilization

PACKING plant practice of using all but the "squeal" of meat animals has far surpassed utilization of farm crop plants or plant parts. If there is to be any comparable utilization of vegetative matter, the greater bulk, greater volume of water, and usual lower unit value of vegetative materials point to initial processing closer to the farm than is the case in the centralized meat packing industry.

Chemurgic emphasis upon the importance of low cost of agricultural materials to the processing industries, together with the obvious requirements of profit to the farmer, suggest the desirability of more complete use of farm crops.

Economic justification for agricultural production of any one species or variety of plants usually is found in the food, fiber, or chemical value of one, or sometimes two, of its parts—roots, tubers, bulbs, stems, leaves, flowers, fruit, seed, or sap. The remaining parts are often completely wasted, or sometimes find a secondary use as stock feed or humus material returned to the soil. Cotton seed is the classic example of a plant part once wasted but now widely used. The Iowa cornstalk harvesting research, on the other hand, illustrates some of the cost limitations that are bound to appear where the harvesting of an extra part of a farm crop involves extra farm operations.

Be that as it may, some remaining possibilities appear to be worth investigating. Could simple, low-cost equipment for initial processing on the farm, during the winter and other periods when there is little field work, be developed? Could it include a fireproof, explosion-proof solvent extraction process for vegetable oils? Could it include cutting, grinding, compressions or other mechanical preparation of plant parts? Could the chemical industries use, mixed or graded, farm-prepared dry fibers or raw cellulose? Could they use, as raw material, farm-prepared liquid concentrates of primary organic compounds, produced by cutting or grinding and pressing certain plant parts; by fermentation and evaporation; by dry distillation of fibrous materials which would otherwise be waste; or by any combination of such processes?

To the extent that farm crops could be more fully and economically utilized, yields would, in effect, be increased and unit costs of production decreased. It would bring farmers and the processing industries closer to a sound, mutual-profit basis for doing business. We mention the possibility not as an imminent industrial revolution, but as a technical frontier worth further exploring.

Reflected Trends

A STATISTICAL study of publications listed in the bibliography of agricultural engineering recently published by the U. S. Bureau of Agricultural Engineering throws some light on the extent and direction of work being done in this field by public service agencies.

Of the 4103 articles listed, more than half have been published since the beginning of 1924. Growth of interest in and support for agricultural engineering subjects is further indicated by the fact that more publications thereon are now issued annually than were issued in the whole previous century. From 14 publications in 1900, the yearly number increased irregularly to a secondary peak of 242 in 1917, decreased to 82 in 1921, and built up to a new high of 280 during each of the years 1931 and 1932.

Among the several sources of publications listed, the state agricultural experiment stations rank first with 1538 contributions; the state extension services second with 1465 contributions; and the U. S. Department of Agriculture third with 972 contributions. Miscellaneous other federal and state sources account for the balance of 128 publications listed. Analysis of publications by years, within classes and subclasses of subject matter, showed no consistent time lag between the appearance of experiment station and extension service bulletins on the same subject. Parallel increases and decreases in publications of the two services in many years and subjects was more strongly suggestive of parallel subject matter interests and financial support. No breakdown was made of the USDA and miscellaneous publications as to their technical or extension character.

Within the subject matter classifications, land utilization and development reflects strong early interest and fairly consistent continuity to a leading total of 1328 separate articles. A growing interest is shown in buildings, beginning notably in 1916, sufficient to make it a close second in total publications, with 1300 under this heading. Structural equipment, separately classified, has commanded a lesser but more or less parallel interest sufficient to place it fourth, with 436 published contributions.

Third place in number of publications is held by machinery and equipment, with 610 items accumulated. Interest in power of any and all kinds was spasmodic up to 1918, with several years in which no publications on the subject are listed. Since then, however, interest has been substantial enough to build up a body of 303 articles on the subject.

There are a few striking examples of division of interest. In hydraulics a substantial body of research reports is not balanced by any comparable number of extension publications. The same is true of irrigation. Perhaps the information developed is not of direct significance to farmers, or is given to them under other names. The USDA has provided all but 2 of the 17 listed contributions on flood control. On the other hand, it has left land clearing, soils, fertilizers, general discussion of power, animal power, wind power, electric power, buildings, and structural equipment mostly to the separate states as subjects for publications.

Land clearing is the only important classification in the field which shows a consequential recession of interest in the present decade. General increase of interest in most of the other subjects is indicated in the total figures previously indicated.

It is interesting to note that the first publication on animal power was issued in 1918, the first on automotive in 1915, the first on labor in 1911, the first on engines in 1907, and the first on electric power in 1891. Apparently the relative practical importance of the various forms of farm power at times in the past has not been a determining factor in the engineering interest therein shown by men employed in the service of agriculture.

In addition to a young and rapidly growing field, vital in all its subject matter, the figures suggest trends toward applying engineering concepts on a broader scale; away from the superficial, toward the fundamental; from the strictly technical toward the practically possible, and the economically and socially desirable; and toward a closer, more fruitful cooperation between agricultural engineering and other fields of technology.

Problems Peculiar to Irrigation Farming

By O. W. Israelsen

CAN YOU imagine the tremendous changes that would be required in American agriculture east of the 100th meridian, if the annual rainfall should decrease to 15 in or less, thus making it impossible to grow crops without irrigation? Suppose the farmers in the states east of the Dakotas, Nebraska, Kansas, Oklahoma and Texas should be required to build large storage dams, diversion weirs, headgates, flumes, spillways, siphons, drops, chutes, and long canals in order to continue their farming activities; and to convey water great distances to their lands, and try to spread it uniformly over the land surface from 4 to 10 times or more each season. Then you can conceive of some of the problems that are peculiar to irrigation farming.

Satisfactory solution of these problems commands the efforts of statesmen, agricultural engineers, attorneys, economists, and scientists—particularly agronomists, soil specialists, and irrigation scientists—as well as the irrigators themselves.

From the beginnings of modern irrigation in America, the problem of providing for an ample and safe supply of irrigation water has perplexed irrigators. For the pioneer irrigators there was plenty of water in the streams and their problem was to build safe diversion dams and ditches of adequate capacity. They needed and used only the natural flow of the streams, which today is entirely inadequate. More and more it is necessary for the irrigation farmer to store the flood waters, either in surface reservoirs or in ground water reservoirs and hold them till needed for irrigation.

The problem of storing water for irrigation in surface reservoirs has become a widely recognized problem peculiar to irrigation farming and hundreds of millions of dollars have been spent for this purpose. Yet the task is less than one-half complete. On some river systems, such for instance as the Sevier River in Utah, practically the entire annual water yield is controlled by storage in surface reservoirs. All of the water produced each year by this river since 1922 has been used for crop production, and there has been no waste.

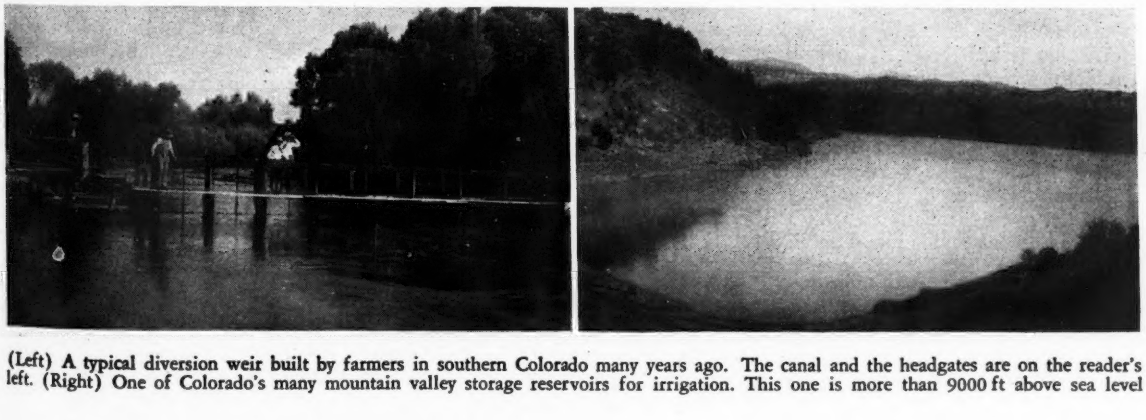
Author: Professor of irrigation and drainage engineering, Utah State Agricultural College, also irrigation and drainage engineer, Utah Agricultural Experiment Station. Mem. ASAE.

Similar water control is needed on other river systems and will be needed more and more as the years go by.

The annual water yield of a river and the distribution of the yield during the year vary between wide limits. Some rivers during years of maximum yield produce from 4 to 5 times as much water as they do in years of minimum yield and similar variations occur in the seasonal distribution. Probably most of the rivers of the West yield less water annually than is needed for all of the arable land on which water may be used for irrigation. Therefore, the problem of determining the area of land for which the water will provide a safe and ample annual supply is not only peculiar to irrigation farming, but it is also very complex. During cycles of wet years there is a tendency to expand the area to an extent beyond which the water supply will provide ample water during cycles of dry years even though all of the water is stored. The first reservoirs were small and were provided by constructing low dams. The problem of today is to build high dams from 100 to 500 ft or more, and this demands the cooperative efforts of many irrigation farmers with governmental agencies, both state and federal.

Hundreds of thousands of acre-feet of water flow each year into ground-water reservoirs which provide storage till the time of need. To get water from such reservoirs it is usually necessary to operate pumps. The capacity of pumps used for this purpose ranges from only a fraction of a second-foot (cubic foot per second of time) to more than 12 sec-ft and the height of lift from less than 10 ft to more than 800 ft. Some of the problems of irrigation farming are to use our ground-water reservoirs more completely and efficiently; to avoid annual water draft in excess of the annual water recharge; and to provide artificial recharge in places where the natural recharge is inadequate to meet the pumping demands; also to protect all vested rights to ground water without ruinous litigation costs.

With but a few exceptions today water must be conveyed long distances from the places of storage in the reservoirs and the points of diversion from streams to the irrigated land. Reservoirs are sometimes located 200 miles or more up stream from the lands that need irrigation. Natural water courses in which late-season nonstored water flows must also be used to convey stored water from reservoirs owned by different groups of farmers. The water that



(Left) A typical diversion weir built by farmers in southern Colorado many years ago. The canal and the headgates are on the reader's left. (Right) One of Colorado's many mountain valley storage reservoirs for irrigation. This one is more than 9000 ft above sea level

is released from storage is neither "branded nor marked". It must be commingled with the water owned by the early appropriators. Some water is inevitably lost in conveyance. To determine the amount of loss and to apportion the proper amounts to each of the irrigation companies, and later to the many irrigators, is a problem that requires a high degree of skill and confidence to solve with satisfaction.

Irrigators have built diversion weirs ranging from less than 100 ft in length to 5,000 ft or more. The water supply for the farm depends on the adequacy and the stability of the diversion weir; if it fails the farmer is without water.

Canals built along steep side hills, sometimes in unstable materials, are even more susceptible to damage and failure than diversion weirs. Eternal vigilance and persistent effort on the part of irrigation company officials is required to keep canals safe and to convey water many miles to places of use. One of Utah's canals having a maximum capacity of more than 300 sec-ft is more than 60 miles long; Idaho has canals of nearly equal length and much larger capacity, and California has one more than 100 miles long with a capacity of 7,000 sec-ft, or approximately 3,500 Utah "irrigation streams".

It is a real problem peculiar to irrigation farming to keep thousands of canals clean and safe and to make them function efficiently.

Although every irrigation farmer may be interested in the storage of water and its conveyance to his farm, yet these affairs are usually under the direct supervision of his representatives, that is, the directors of a corporate irrigation enterprise. However, in the application of water to the land, every irrigation farmer is *directly* concerned. His objective is to apply the water in a way that will assure storage of the maximum amount of capillary water in the soil for use by crops and reduce to a minimum his wastes by surface runoff, deep percolation, and evaporation. Uniformity of distribution of water over the land surface contributes to the attainment of his objective. Solving of the water application problem would be easy for the irrigation farmer if he could at reasonable cost "make it rain" uniformly at a rate that would not exceed the rate at which his soil will absorb the water. Considering irrigation as a whole, there is but a very small per cent of the land irrigated by the "rainfall" or spray method. The irrigation farmer is therefore confronted with the problem of applying water by flooding or in furrows. He must, as a rule, attempt to adjust the time rate of application so as to get the most uniform distribution practical. The problem is complicated by the number of the variables with which he is confronted, and by the wide degree of their variability. There is no such thing as complete uniformity on the irrigated farm. The land topography is variable; on one part of many irrigated farms the land has a flat and nearly smooth surface, while on another part it is steep and irregular. The size of the stream delivered the farmer, the size of the farm, its shape, and the nature of the crop are significant variables; but of all of the variable factors, the variability of the soil is the most difficult to cope with. Soils vary in depth, in structure, in texture, in water-holding capacity, and particularly in permeability. It is not unusual to find one soil having a permeability 100 times that of another soil near by. Comparisons of the permeability of the surface foot of a clay soil with that of the underlying sand and gravel made recently by the Utah Agricultural Experiment Station show a variability of 1 to 100,000. The irrigation farmer must deal with these variables in his attempt to spread water uniformly over his land.

Some soils absorb water so slowly that many hours of contact of the water and the soil are required to get the necessary amount of moisture stored in the soil to the desired depth—others absorb it so rapidly that the soil is fully wetted and large, deep percolation losses occur near the upper ends of the fields before the water reaches the lower ends, and so the irrigation farmer must continuously seek to obtain a balance between the size of the stream he uses, the length of his irrigation "run", the width of the land covered at one time and permeability of his soil.

Is it any wonder that he needs the assistance of the agricultural engineer to find the methods and the procedure that will assure the highest efficiency consistent with economy?

The irrigation farmer cannot produce satisfactory crops without keeping readily available moisture in his soil during the growing season. One of his problems is to find how much moisture there must be in his soil in order that his crops can get water easily and grow satisfactorily. Plants cannot grow without food, and they cannot get food without water. Some soils may contain as much as 16 to 18 per cent of moisture, dry weight basis, and yet have none available to plants, whereas other soils may contain only 5 per cent or even less, and yet have a readily available supply for crops. The farmer must therefore learn how to determine quickly and easily whether or not his soil has a supply of readily available moisture, and thereby tell when irrigation is needed.

The appearance of the growing plant and the moisture condition of his soil, are two major indices for finding when irrigation is needed, and he must, if he would get the most out of his soil and water resources, learn how to interpret the appearance of his crops and to find by soil borings and inspection whether or not his soil contains readily available moisture.

The irrigation farmer should know how long it will take him to fill the capillary reservoir of his soil with the stream of water that he uses. If, for instance, his soil needs to be wet to a depth of 4 ft, and if the capacity of the capillary reservoir of the soil is 1 in depth of water to a foot depth of soil, he knows that he must provide 4 acre-inches to each acre of land. Knowing the area of land that he wants to irrigate, he can compute the time required with a given stream to get the volume of water to be stored in the soil.

It is too costly for the average farmer to determine directly the capacities of his capillary water reservoir, but if he can get this desired information from public research agencies, then he can proceed to apply water to his land intelligently and efficiently.

He must, to be sure, understand the elements and practices of water measurement, and he should see clearly that, if he applies more water than is needed to fill the capillary soil water reservoir, the excess will not only be lost, but it will percolate down to the ground water and ultimately cause a rise of the water table with its inevitable contribution to the alkali menace.

Soluble salts, such as the chlorides, sulphates, and carbonates of sodium, are toxic to plants and injurious to soils, if they occur in excessive amounts. From soils having a water table near the surface there is continuous evaporation of water. The soluble salts, or alkalis, do not evaporate—they become concentrated on or near the land's surface and make the soil non-productive. The irrigation farmer who owns land subject to alkali accumulation and concentration, must exert continuous vigilance to maintain the productivity of his soil.

Adequate underdrainage which will assure a general

lowering of the water table and the downward movement of alkali salts with the excess irrigation water is the basic means of permanent alkali control. This fact is well recognized by irrigation authorities, and many thousands of acres of irrigated land have also been drained. But drainage, even more than irrigation, is a community problem and requires joint action. I know of many owners of irrigated land whose annual profits are low because of alkali injury to land once highly productive. Yet drainage is delayed year after year because of the "inertia" of some of the landowners.

The greater percentage of irrigated lands have but little if any value without water, and irrigation water is a mobile and a liquid asset. Most of the states have maintained and declared ownership in the water of all natural sources, and have granted to individuals certain right to use the water for beneficial purposes. Those who provide for new diversions from streams, build new reservoirs, or drill new wells to get ground water frequently make, unintentionally, infringements on the rights of earlier water users, with the result that one of the problems peculiar to irrigation farming is almost continuous self-exertion to protect one's water right.

Some of the vigorous, self-reliant early irrigators settled their water right disputes in the open fields and on the ditch banks with strong arms, shovels and shotguns. The second and more peaceful, though very expensive, method is to litigate differences in the courts. Since the farmers themselves are seldom sufficiently informed concerning all of the *facts* needed by the courts, there has come a demand for agricultural engineers and agronomists to study irrigation requirements and present the facts in so-called "expert" testimony. Because of the many variable factors involved, it is very difficult to find the whole truth concerning the facts on which water-right determinations are based. Therefore, many irrefutable contradictions have been made in the courts by lay witnesses and by specialists, so many indeed as to confuse the best of judges.

The more recent and by far the more sane, intelligent, and hopeful method of settling water-right controversies is by commissions and compacts. A notable instance of the use of this method is the supervision and coordination by the National Resources Committee of the work of several federal government bureaus in a thorough and comprehensive investigation looking to the permanent solution by compact of water distribution problems in the Rio Grande basin involving both interstate and international relations. Water-right controversies will no doubt continue to "come up" for many years.

Brief mention of a few other problems may be of interest. Water for irrigation purposes is considered by law as a use secondary to the use for culinary and domestic purposes. The growing populations of cities are demanding for culinary uses water formerly used for irrigation, giving rise to some perplexing problems in changes of use and water-right protection.

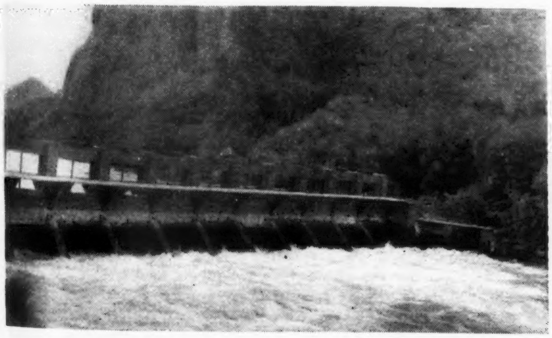
On some streams interstate water controversies are very difficult of solution. Transmountain water diversions could be made economically but are impeded by legal complications. In some localities vested power rights on the lower reaches of streams form insurmountable barriers to the diversion of water up stream for use on the higher lands needing irrigation.

In conclusion, it must be observed that I was assigned the task of talking about problems peculiar to irrigation farming. However, lest I leave an impression that these problems are insurmountable and that the case for the irrigation farmer is hopeless, I must assure you that beyond any doubt whatsoever, the *privileges* peculiar to irrigation farming greatly outweigh the problems.

Very substantial progress toward the solution of irrigation problems on the farm has been made by the U. S. Bureau of Agricultural Engineering and the agricultural experiment stations. There is yet much to be done in the search for new facts concerning irrigation farming as well as in more extensive use of the facts thus far established.

The problems peculiar to irrigation farming present a challenge to agricultural engineers; the privileges offer adventures in contentment to rural-minded people. Despite the number and the complexities of the problems peculiar to irrigation farming, it is certainly a permanent, substantial, and sound branch of American agriculture. The farmer who has clear title to good productive land and a vested right to ample water with which to irrigate his land, enjoys an economic security which contributes to the making of the best elements in our democracy. This farmer never has complete crop failures due to drought. The year of drought is one in which he must irrigate more intelligently, and indeed more vigorously; and it may be one also in which he will not trade in his last year's automobile, but if he has, along with his good soil and good water supply, a reasonable amount of energy and good judgment he rarely has delinquent taxes despite the adversities of the changing value of our money; and he is neither a case for the Resettlement Administration nor an eligible for the Public Works Administration.

Intimate acquaintance with the living conditions on many irrigated farms leads me to conclude that our beloved agricultural engineer, the late Dr. Elwood Mead, was perfectly right when he said, "It is a privilege to live on an irrigated farm."



(Left) The headgates of a large canal taking water from the Rio Grande River in Colorado. (Right) Where a high dam may be built to store irrigation water on the Rio Grande near the Colorado-New Mexico boundary

Structural Insulation Board for Poultry Houses

By H. M. Ward

THE most common type of insulation used in poultry house construction is structural insulation board. This type of insulation is most desirable because it can be used to replace non-insulating building materials. It may be employed solely for its insulating value, although, because of its rigidity, it is generally used as a combination insulating and structural material, such as outside sheathing, plaster base, or interior finish for walls and ceilings.

During the past year a great many poultrymen have used structural insulation board one inch thick with galvanized sheet steel roofing and siding as a means of reducing poultry house costs. The one inch of structural insulation board provides a great deal more strength than is required for construction of this type. In other words, one inch of structural insulation board has strength enough to support 175 lb, when used as roof sheathing with rafters spaced 24 in on centers.

Tests were made at the University of Minnesota by Frank B. Rowley, professor of mechanical engineering, to determine the relative or comparative bracing strength of structural insulation board ½ in thick, when dry, and after being subjected to a spray of water for fifteen hours, as compared with 8-in wood shiplap sheathing, which is considered standard construction.

The framing for the test section used was 8 ft high and 12 ft long, and was built up by using a 2x4-in plate at the top and bottom, with 8-ft vertical studs placed 16 in on centers. The center line of the wall was braced with horizontal 2x4 pieces nailed between the studs, corresponding to ordinary construction of fire blocking.

Presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 24, 1937.

Author: Masonite Corporation.

In building the frames, the top and bottom plates were spiked to the end of each studding with 20d spikes. The horizontal cross braces were nailed in place with two 16d nails at each end. The wall frames were all built from No. 2 fir, and were identical for all tests, in order to eliminate all items of strength, except that of the sheathing.

The structural insulation boards used as a sheathing material measured 4 by 8 ft. They were all taken from the dealer's warehouse stock, and represent the quality of material available to the trade. The wood sheathing used in these tests consisted of 1x8-in No. 2 shiplap, the grade and quality furnished for No. 2 common in the Minneapolis market.

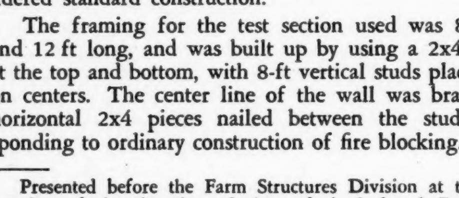
The structural insulation was nailed to each stud with 1½-in barbed roofing nails having a ⅜-in head, spaced 4 in apart and ⅜ in from the edge of the material. The nails were driven flush with the surface of the board.

With regard to the effect of moisture on the material, the 8x12-ft panels did not show any warping or buckling after being subjected to a spray of water for 15 hr. The strength of this wall, immediately after being taken out of the spray, was three-fourths that of the dry material.

This shows that ½-in structural insulation has plenty of strength when used as a wall covering material for poultry house construction.

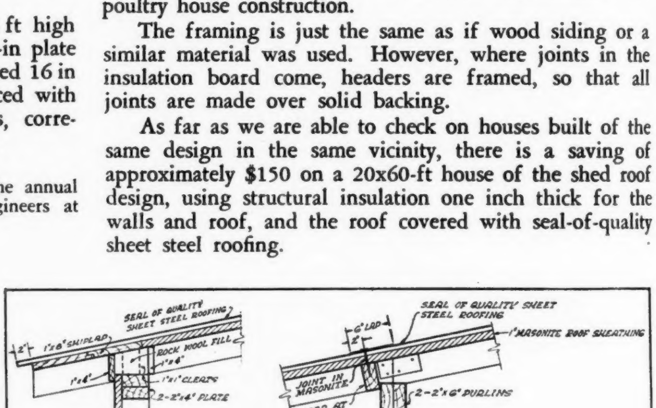
The framing is just the same as if wood siding or a similar material was used. However, where joints in the insulation board come, headers are framed, so that all joints are made over solid backing.

As far as we are able to check on houses built of the same design in the same vicinity, there is a saving of approximately $150 on a 20x60-ft house of the shed roof design, using structural insulation one inch thick for the walls and roof, and the roof covered with seal-of-quality sheet steel roofing.



MATERIAL	WEIGHT	"P"	"d"
1"x8" WOOD SHIPLAP	309#	2100#	8.14"
½" STRUCTURAL INS.	218#	4200#	1.29"
½" STRUCTURAL INS. & ½" INSULATING LATH	285#	*5000#	*0.78"
½" STRUCTURAL INS. WET	281#	3000#	0.98"
½" INSULATING LATH	218#	1900#	2.62"

"P"-PRESSURE APPLIED BY SCREW JACK. "d"-DEFLECTION. *LIMIT, PANEL DID NOT FAIL



(LEFT) DIAGRAMMATIC SETUP FOR TEST OF ½-IN STRUCTURAL INSULATION AS SHEATHING. (RIGHT) DETAILS SHOWING APPLICATION OF STRUCTURAL INSULATION IN ELEMENTS OF POULTRY HOUSES

Fence Test Progress and Fencing Problems

THE American Society of Agricultural Engineers in 1933 took out membership in the American Society for Testing Materials, and appointed the present chairman of your committee as official representative to cooperate with the wire test committee of Subcommittee VIII of Committee A-5, ASTM, in completing the steps necessary to bring about the inauguration of atmospheric exposure tests of wire and wire products, which ASTM had had under consideration for some years.

Your representative served in this capacity and found that he could function principally as a proponent and guardian of the interests of agriculture in the discussions that took place, and as an intermediary between the academic authorities at the colleges where the tests were to be set up and the ASTM authorities, who represented not only consumers but also the producers of wire goods who had, incidentally, contributed largely to the fund which made the tests possible.

It is a pleasure to report at this time that all fears, doubts, and differences of opinion have been met and eliminated; completely satisfactory cooperative agreements have been signed between ASTM and all the colleges involved; the test materials have been received, prepared, and, last winter, were set up at all the yards; and the tests are now actually in progress. A potent factor in the attainment of this successful conclusion has been the highly efficient leadership of F. F. Farnsworth, chairman of the ASTM wire test committee and, latterly, chairman also of Committee A-5. Through the broad experience and painstaking care of H. E. Smith, engineer of tests, the important routine of labeling the samples and properly mounting and erecting them has been so accurately attended to as to eliminate all fear of error in that regard. The most important test of this kind ever undertaken in this country is, therefore, now successfully under way.

The complete early history of the wire test program, its scope and methods of procedure, and the personnel responsible for carrying it out was published in the 1934 proceedings of ASTM, and a final report on the setting up of the tests is given in the 1937 proceedings. It is estimated that when the last report is completed, twenty years or more from now, the whole investigation will have cost approximately $100,000.

As a matter of brief record here, it may be reported that these tests are located at eight sites under seven state colleges and at three industrial locations as listed below. There are exposed, at each of the college sites, 67 samples of farm fencing, each one rod long, 22 samples of barbed wire, and seven duplicate sets each of 120 samples of straight wires on frames, which wires are to be cut up and tested at the U. S. Bureau of Standards laboratory at intervals during the 20 years of test. These straight wires include all the wires used in the woven fence and barbed wire samples and many more besides.

In the test materials there are included uncoated wires of copper-bearing and of non-copper-bearing steel; copper-bearing steel wires in five sizes from very small to very large, coated with galvanizing in six thicknesses ranging from very light to very heavy; there are steel wires, lead covered and copper clad; there are stainless steel wires and galvanized wires that have been treated with dichromate solution.

In the list below are given the locations of the college test yards and the names of the men who will locally represent the ASAE as members of the fence test inspection committee of Sub-VIII of A-5 of ASTM.

Cornell University, Ithaca, N. Y. (B. A. Jennings)
Iowa State College, Ames, Iowa (Henry Giese)
Kansas State College, Manhattan, Kan. (F. C. Fenton)
Pennsylvania State College, State College, Pa. (R. U. Blasingame)
Purdue University, Lafayette, Indiana (I. D. Mayer)
Texas Agricultural Experiment Station, College Station, Texas (H. P. Smith)
University of California, Davis and Santa Cruz, Calif. (J. D. Long)

The industrial sites are at Bridgeport, Conn., Pittsburgh, Pa., and Sandy Hook, N. J.

Present Problems. The recent development of commercial methods for the production of practically pure zinc has placed on the market a metal which is ductile in contrast to the impure commercial zinc which has long been used for galvanizing and which is brittle. This essentially new metal is now being used, by one firm, for galvanizing fence wire electrically from an electrolyte carrying zinc chemically removed directly from the zinc ore; by another firm, electrically from a secret commercial electrolyte carrying zinc supplied from commercial bars of the pure metal; and finally by hot dipping in a bath of the same practically pure zinc.

The ductility of the new zinc removes one of the major obstacles that have in the past stood in the way of heavier galvanizing on our farm fences. If now the worth of heavy coatings becomes apparent to the buying public, it is fair to assume that there will be questioning as to the relative advantages of the three methods of application just cited. This is a matter that your Committee on Fence Testing might well investigate so far as possible in the near future.

The so-called electric fence has sprung into sudden prominence. Many devices for controlling central station current for this purpose are being offered for sale, some being carefully engineered, others devised by tyros. In some instances 110-volt lines are being ignorantly connected directly to fences or through light bulbs so large as to be without any protective effect. A farmer's daughter was recently killed by a directly connected fence in New York state, the child's feet being in a pool. In another instance nearby, a child that had "frozen" on a fence was pulled off by playmates, and in still another instance a young boy was rendered breathless and speechless when wet grounded from a fence and released only by the operation of the in terrupter. Of all three of these instances the writer has received reports from individuals personally familiar with the occurrences.

The ideal electric fence is of great value to farmers on three grounds; it effectively restrains cattle, it materially reduces fencing costs, and it is especially useful for temporary fencing. This ideal fence is not only safe under all conditions when first made, but also it is so designed and constructed that there is no possibility of danger from subsequent breakdowns from *(Continued on page 444)*

A contribution of the ASAE Committee on Farm Fence Testing —H. W. Riley (chairman), Kirk Fox, F. C. Fenton, J. D. Long, R. U. Blasingame, I. D. Mayer, H. P. Smith, and Henry Giese—presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 24, 1937.

Design Factors for Small Farm Homes

By H. E. Wichers

IT SEEMS that the most important factor in the design of farm homes today is that of selling farm homes to farmers. It is necessary to awaken a strong desire in the minds of farm people for farm houses before anything of lasting value can be accomplished, and at the present time we have only started to awaken this desire for good farm homes among farm families. Much needs to be done to picturize the good that can come from good farm homes. Of course, we must retain an intelligent viewpoint; we must not encourage farmers to build beyond their means, or we will defeat our ultimate objective. But it would seem at the present time that there is little danger of doing any such thing. The vast majority of farm homes lag so far behind, in the matter of equipment, arrangement, and appearance, that it would take several years of persistent effort on the part of the state agricultural colleges and other agencies, to bring them up to a reasonable normal. We can not and will not stop our research and study of the farmhouse problem. But we need to put greater stress on the fact that material we already have has a bad habit of remaining on the shelves in our storerooms.

We know a great many things about farm house design, its relation to farm work, and farm living, that have not been disseminated. We need the help of the farm press, farm magazines, and the extension service to put this information out where it will be properly used. A vivid example of the amount of work yet to be done was expressed in a round about way in the farmhouse planning contest held in connection with the Better Farm Homes Train in Kansas. In this contest we received 240 farm house plans worked up by members of farm families to fit their particular needs and problems. The plans required considerable effort. We received first and second and sometimes basement floor plans. Out of 240 plans received, 17 were of farm houses; the rest were for urban and suburban homes. Obviously the people who designed these houses used local lumber yard plan books and their neighbors houses, as suggestive material in designing their own homes. The idea is that most of these farm families did not know the difference between a farm house and an urban house. It is high time we sold our own extension service the material that we have. It isn't enough to prepare material. That material must be presented to the general public in such a way that they will receive it understandingly.

Recently I made a quick study of farm magazines to find out what kind of material they were presenting in regard to farm house design. I found only a few who were doing something about it. I found some who were doing just a little, once in a long period of time. The sad part of it was that some of these magazines were not presenting farm houses to farm people; they were presenting suburban house material to farm people.

It may help for me to point out, as forcibly as I can, the three points in which the farm house differs from the suburban house. Of course there are other minor, secondary differences, but they mean little at the present time. If we can confine our effort to these three major differences, we will accomplish much in the next ten years. The exterior design, of course, is important. So is the design of rooms. But if we can establish the three main ideas, I am certain that the rest will gradually come along.

The first and most important of these three points is a *central rear hall*. It takes very little observation to prove conclusively that the larger percentage of farm traffic to and from the house is through the rear door. Therefore, that rear door should lead to a hall which in turn leads directly into all rooms of the house — workroom, washroom, bedrooms, living room, dining room, kitchen, basement, and second floor. If we are at all reasonable, we design the farm house for the farm family, not for the occasional visitor.

Second, most all old farm houses, and all suburban or urban houses, have the front door facing the highway or street. The new highway system has changed this, as far as the farm house is concerned. The front door facing the highway, with the walk leading to the highway, is no longer useful. In most cases there is a ditch between the highway and the front yard which the highway department insists on keeping free of obstacles. Further, the highway provides a culvert for the farm driveway. The driveway is the entrance to the farmstead; so the front door should face the entrance drive and not the highway. To show that this is a real problem and not an imaginary one, hundreds of letters come in every year asking "What can I do to get my visitors to come to the front door?" The answer is obvious and very simple. And the fact that they continue to ask that question shows clearly that information available is not being disseminated.

The third element, is the workroom. It is based on something very old and something not so old. It is a revival of the old English scullery idea, and a slightly different use of the summer kitchen idea. There is a lot of heavy work, rough work, that should be done in a farm house workroom; there is canning, laundering, taking care of meat. Occasionally something happens to the prize calf and it finds its way to the kitchen in present-day farm homes. It should find its way to the workroom. Occasionally there are a few chicks that are hard hit by a storm, these few chickens will find their way to the kitchen unless there is a workroom. This workroom should have a concrete floor with a floor drain, a cabinet, a sturdy table, a sink, and a stove. It should be heated for constant use in the winter time. It should connect with the central rear hall and should also have an outside entrance. It should be located on the first floor. It is so constantly used that it should occupy the most convenient position possible. At the present time, some few of them are being built in basements; they serve very well as a compromise feature, but obviously that is not the best place for them.

Here then we have the three main elements in which a farm house differs from all other houses. These three elements, brought to the attention of farm people, are not difficult to sell to them. But farm people are specialists like all the rest of us, and they look to other specialists to take care of things that they need but cannot supply for themselves. So it is up to us to make these things known to them.

Presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 23, 1937.

Author: Associate professor, department of architecture, Kansas State College. Mem. ASAE.

Farm House Design for Architectural Beauty

By Rexford Newcomb

ANY INSTITUTION that long retains the regard of human intelligence justifies itself by virtue of its possession of one or another of three characteristics. It must appeal to the human mind because of its intrinsic goodness, truth or beauty. Architecture, in a peculiar way, presents all three of these characteristics, and any evaluation of its merits must of necessity consider these aspects. The goodness of architecture is shown by the fidelity with which its forms express its functions. A building—whether it be a church, a school, a filling station, or a farm house—should express in external form its inner uses or meaning. A church that looks like a bank or a house that resembles a barn defeats its own ends.

A work of architecture must be good for that which it is intended. Thus the goodness of architecture is identified with utility. The truth of architecture is its structural stability, its verity. The beauty of architecture has to do with appropriateness and pleasantness of form, line, color, the pleasure it gives the senses, the delight it affords the human mind.

But goodness, truth, and beauty; or utility, stability, and beauty in building are so intimately related that no work of architecture can be truly beautiful unless it be eminently fitted to its purpose (is utilitarian) and strong enough to function adequately—that is, is stable.

Beauty is an elusive quality and depends somewhat upon the accidents of historic and geographic association. Each race and each age brings forth its concept and norm of beauty. I would have you remember that, to the Eskimo, the Eskimo is beautiful and, to the Hottentot, the Hottentot is beautiful. Let us therefore analyze this quality of beauty a bit further to discover, if possible, its true nature. It would seem to me that that quality which we call beauty depends upon two principal components. These might be described as (1) appropriateness, that is, as to time, place, materials, and function, and (2) agreeableness, that is, as to form and color.

Appropriateness to time and place means to be in harmony with racial, social patterns and geographic location. The Egyptians out of their peculiar racial configuration and in their peculiar geographic setting brought forth an architectural expression as unique and distinctive as their religion or their social customs. Architecture at its best always maintains a close relationship to the culture pattern which gives rise to it.

Geographical location, that is to say, climatic setting, topographical background, and natural resources, condition the expression of architecture as effectively as do racial pattern and position with respect to the stream of world history. Racial pattern and culture condition social usage, and these, in turn, determine the functions demanded of human shelter. Thus architectural beauty is an indigenous quality and pertains to time, to place, and to the substance in which it enunciates itself.

By agreeableness of form and color we mean that harmony with environment—geographical, racial, and temporal—that insures delight to the senses of the beholder. Mountainous terrains bring forth one sort of architectural expression, desert situations another, maritime exposures another, and so on.

Therefore architectural forms to be considered beautiful, must agree with general environmental facts and exhibit a degree of harmony therewith. These environmental facts are geographic setting and the human element. Architecture expresses human needs, aims, ideals, longings, and is the vehicle by which man accommodates himself to and triumphs over the environmental background of which he himself is a function.

If what I have said be true, let us analyze for a moment the farm house problem. First of all, I think we must remember that the American Union is a far-flung sisterhood of states with widely divergent traditions, social fabrics, economic backgrounds, natural resources, and climates. It will be immediately recognized that a farm house adapted to life in Maine or Michigan would be out of place in Florida, New Mexico, or California; and that the plantation types of the lower Mississippi or the Gulf terrain would appear exotic in Wisconsin or Minnesota. Appropriateness to place, social pattern, and materials therefore demands a certain regional reference. The first rule to remember in determining the type or style for a particular situation is this: *Never force a house into a situation with which its heredity, lines, and forms are not in harmony, or in which it would appear exotic.* There should be a correct farmhouse type for every regional setting, and if we have any inventiveness or ingenuity as creative artists or interpreters of our life and time, we should be able to develop types perfectly adapted to the various regions in which American farmers build. True architectural beauty is not necessarily to be captured by the selection of some existing style and its adaptation to a particular problem. It is rather to be achieved by the solution of all the work-a-day utilities demanded in the farmhouse in a straightforward, honest, craftsmanlike fashion.

Now precisely what does this mean? It means:

1 Consideration of site with its questions of exposure to sun, to prevailing winds, and to winter storms; climate—temperature variations, rainfall, etc.; vegetation. Topography, the "lay of the land" largely determines the type of architecture that should be placed upon it. Historically this consideration, like that of climate, has had a marked effect upon the development of architectural form.

2 Consideration of social pattern, including heredity (racial stock), regional customs, and local or family customs, traditions, religion, etc.

3 Consideration of materials, including indigenous resources, economic factors, availability, appropriateness of forms to environment, possibilities and limitations of stone, brick, adobe, timber, etc.

4 Consideration of utilities—water, light, heat, insulation, power, etc.

The correct solution of these background functional facts of the farmhouse should achieve an appropriateness to time, place, materials, and the human factor that spells beauty.

This means therefore that the plan or internal utilitarian scheme of the structure is the first and prime considera-

Presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 23, 1937.

Author: Dean, College of Fine and Applied Arts, University of Illinois.

tion, and that through its correct solution arrive all the other virtues of the house. Once the plan is solved in a simple, straightforward fashion, one may proceed to the consideration of line, form, and color that is to make the external house appropriate and agreeable to its surroundings. A beautiful plan begets a beautiful external envelope and a beautiful plan is the one that works best or ministers most completely to the type of life which finds shelter within the structure. Any plan that is more complicated or less orderly and logical in its relationships than need be is a bad plan. Simplicity and balance, efficiency, and a natural relationship of rooms (based upon usage) are fundamental virtues of a good plan. A good plan achieves economy of space, economy of materials and apparatus, ease of circulation, and pleasant vistas and outlook.

When one comes to a consideration of the external envelope of the farm house, he may have recourse to historic expressions within his region or area. After all we cannot break with history, and America is already old enough to have achieved certain regional folk expressions from which suggestions may well be taken.

For the eastern half of the United States the time-honored and handsome English Colonial types are available. Even here it would be foolish to force exchanges from north to south, or vice versa. The frugal Early American is scarcely adaptable to regions south of the Ohio River and is better adapted to New England and the bleaker situations in our northern tier of states.

In Florida, California, Arizona, New Mexico, Texas, and the Gulf states, types based upon the Spanish Colonial or kindred sunny styles offer a wide latitude.

In the prairie states of the Mississippi Valley, to which, in the pioneer days, simple varieties of the seaboard types were carried, modifications of these old types are appropriate. Ohio, Michigan, Wisconsin, northern Indiana, Illinois, Iowa, eastern Kansas, and Nebraska inherited, through New England immigration, the New England types, modified to meet local conditions. Kentucky, Tennessee, southern Illinois, Indiana, and Mississippi, with parts of Missouri and Arkansas, inherited the more genial southern style of Virginia and modified this to meet the conditions imposed by pioneer life and a changed environment. These interesting old folk types, developed in obedience to natural laws and not tampered with by fads, to this day offer the surest guides.

The prairie states with their long hot summers, their horizontal terrains and other peculiarities, led certain designers to attempt to capture the "spirit of the broad open spaces" and to interpret it in architectural form. As a result there arose in the early years of this century a "prairie school" of domestic architecture. This, through its common-sense appeal and quaint form, enjoyed a vogue for a time, but being principally an architect's style, has not influenced farm architecture markedly. The Middle West in a sense is still a no-man's-land stylistically. It remains for us here to work out a sane architectural expression based upon a logical solution of our utilities, in harmony with our level terrains, our variable temperatures and precipitation, and in terms of our local or available building materials.

In some of our mountain regions charming results have been obtained by an ingenious utilization of native materials, stones, logs, etc. Here a splendid regional, almost Alpine, type has been developed.

Perhaps the best advice that can be given the farm owner is to study existing work to discover wherein it is adapted to or appropriate for the particular situation in which he wishes to build. Select that type that appears "at home" in the community or in communities of similar topography, climate, or floral background, and at the same time is capable of expressing the plan called forth by the type of social pattern to be lived in the house. But any attitude that approaches archæological copying or the perpetuation of past forms that have no utilitarian significance in our day or time should be avoided. Nothing which is not completely expressive of the life of the family or community for which the house is destined should be tolerated. Architecture must grow from the inside out; must, above all, express the life of its time and place. It is not something that can be tacked on after the structure is planned and formed.

Fence Test Progress and Fencing Problems

(Continued from page 441)

any cause; it is effective in restraining cattle under both wet and dry conditions without having the dry setting dangerous for wet conditions; it is so designed that its performance characteristics do not change significantly with changes in the length of connected fence; its stimulating discharges are continually effective, even though an animal persists in crowding the fence, but these discharges are not so delivered as to afford no opportunity for release from their insistence.

The use of battery current for energizing electric fences would seem to involve no great technical difficulty, but the design of control devices to secure from alternating-current all the characteristics of the ideal fence is a problem presenting technical difficulties so serious that home-made devices should never be recommended or used.

Summer Optimum Temperatures for Poultry

SUMMER optimum temperatures for New Hampshire Red laying hens in battery cages were found to range between 75 and 85 F (degrees fahrenheit) for the conditions of a test at the Knights of Malta Home at Lewistown, Pennsylvania, according to Geo. W. Robinson, chief ventilating engineer of the Fuel Oil Heating and Service Co., Lakewood, N. J., which engineered the air conditioning installation.

The test was run this summer on 1200 birds in battery cages on the ground floor of the house. Observations indicated that when the indoor temperature at night was allowed to drop below 75 F the birds became restless, did not sleep well, and dropped off in egg production. When the daytime indoor temperature was allowed to exceed 85 F the birds became loggy, tended to roost, consumed less feed, and dropped in both weight and egg production.

During the time of the test outdoor temperatures ran as high as 114 F. Average indoor temperature of 78 F was maintained in the battery room, which measured 150x30x9.5 ft, by conditioning and circulation of 800,000 cu ft of air per hour under 0.5 in static pressure. Indoor relative humidity was reported to be high, but without visible effect on the birds.

Egg production was reported to have averaged about 50 per cent, although feed used during a part of the time was found not entirely satisfactory. Mr. Robinson is interested in learning the experiences of others as to optimum temperatures, humidities, and volume of air changes for various ages and breeds of birds, and for various outdoor temperatures and humidities.

Design and Performance of a Small Automatic Hammer Mill

By Andy T. Hendrix

RECOGNIZING a definite, unsatisfied need for a feed grinder to operate on one horsepower or less, and to have certain other desirable characteristics, a study of desirable and possible design and operating characteristics was undertaken in the agricultural engineering department of the University of Tennessee in cooperation with the TVA.

To be satisfactory to the greatest number of farmers and to be applicable to a variety of conditions, such a grinder should require low initial investment; should be durable, simple, and free from trouble. It should have a feeding device permitting operation of the mill without an attendant, and should also be capable of grinding certain grains sufficiently fine for human consumption.

Nearly all feed grinders which have heretofore been operated with small motors have been of the burr type. With one exception, all the mills used in the preliminary tests conducted here were burr mills. This one exception was a miniature hammer mill which had been previously displayed to demonstrate the principle of operation of larger hammer mills. This mill was 3½ in wide, had 6-in swing, tangential feed, was equipped with fan and sacker, and was driven by a 1/6-hp motor. While having been built for demonstration purposes only, when placed on actual test and driven at 7000 rpm by a 1-hp motor, this mill gave results indicating that a small hammer mill might well be a very practical grinding unit.

Design of Hammer Mill for Test. In consideration of the apparent advantages of a hammer mill for automatic operation, it was decided to attempt the design and construction of a satisfactory small-size hammer mill. Based to some extent on the design and performance of the miniature hammer mill previously referred to, two hammer mills were next constructed for design and test studies.

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FIG. 1 APPARATUS USED IN SMALL HAMMER MILL AND FEEDER TABLE TESTS

Two types of construction were considered. In the first type the mill shaft and rotor were to be carried by two self-aligning ball bearings mounted on either side of the mill housing, with a pulley for V-belt drive. In the second type the mill rotor and hammers were to be directly mounted on the motor shaft.

The mills were constructed as complete units, using the first type of construction. They were of the swing-hammer type, having specially designed hammers carried by rods passing through holes located near the periphery of circular disks. The disks, three in number, were clamped on the mill shaft by spacers and a clamp nut. Each mill had 180 deg of screen arc, 10-in swing, tangential feed, and was equipped with a fan. Neither of these two mills had automatic feed. One mill was 4 in wide and the other 2 in wide.

Object of Tests. Using the two mills described in the preceding paragraph, the following factors were studied:

1 Effect of fan on mill capacity and on power requirements

2 Effect of mill speed on grinding efficiency and on fineness

3 Effect of number of hammers on efficiency, capacity, and fineness

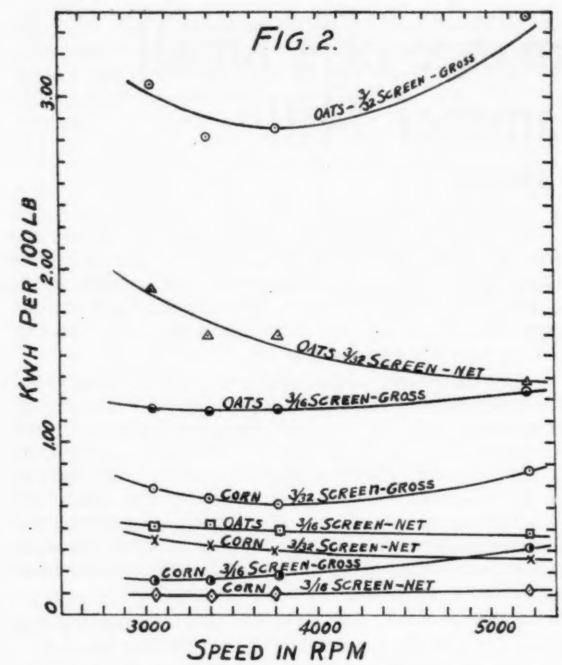
4 Effect of mill width on capacity, power requirements, and on efficiency

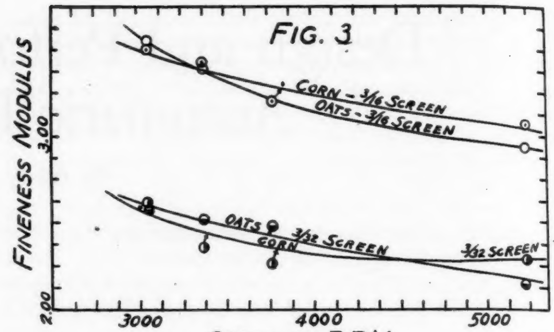
5 Effect of power input on capacity and efficiency.

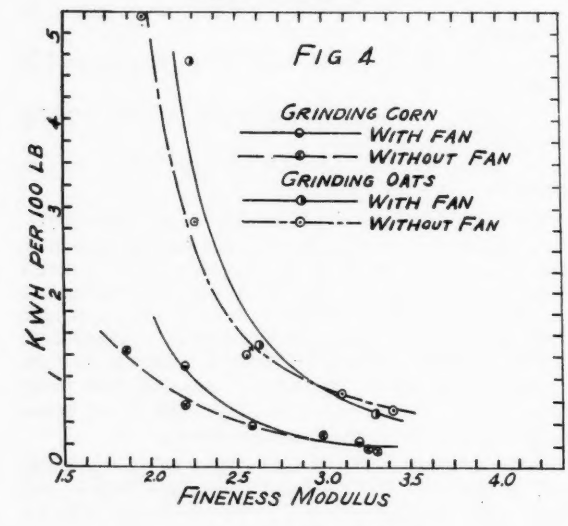
Fineness Modulus. Fineness modulus determinations were made according to the recommended practice of the Rural Electric Division of the American Society of Agricultural Engineers. This proved satisfactory for coarse and medium grinding in general, but materials ground finer (fineness modulus of 2.00 and lower) tended to clog the screens and would not sift through those of finer mesh. This was particularly true of materials such as soy beans. A solution for this difficulty was not found.

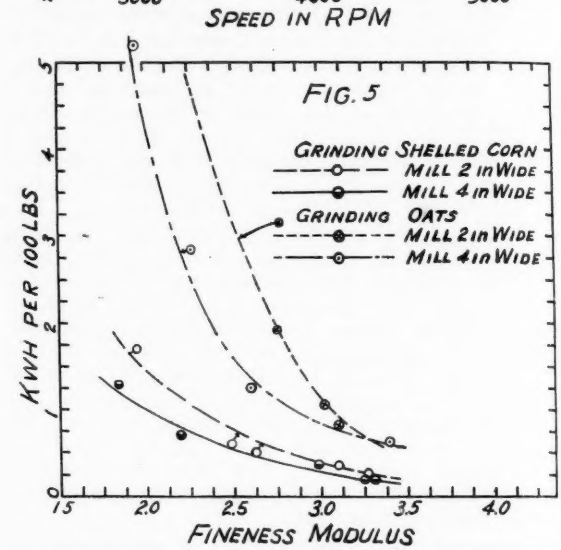
Test Apparatus. Fig. 1 shows some of the apparatus used in the tests. On the left is the supply hopper and feeder spout to supply material to the feed table. A ½-hp capacitor-type motor, wattmeter, self-starting electric clock, recording wattmeter, current transformer, and starting switches are also shown. The handle shown on the front of the test bench was attached to the electric switch shown just in front of the motor, by which the recording apparatus was started and stopped at the beginning and end of each test run. This same handle also shifted a discharge spout which discharged the ground material into a separate container shown beneath the bench. Thus it was possible to record accurate data on quantity of material ground, total power consumed, maximum and minimum power demand, and the duration of the test run. The watthour meter used is not shown in the picture.

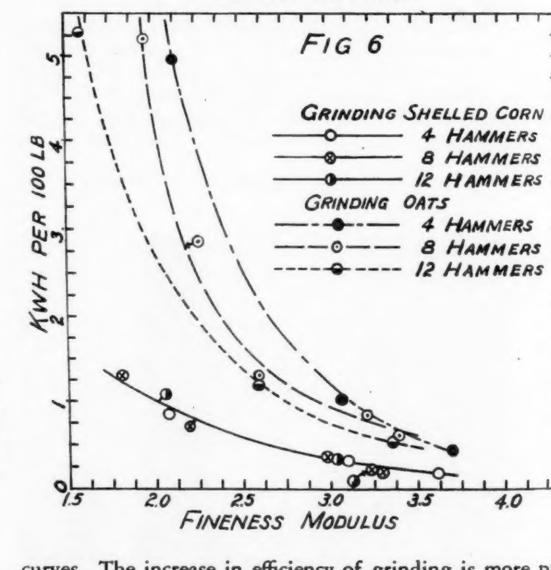
Test Results. For any given set of conditions the motor, belt, bearing, and windage losses were assumed to remain constant. The net power available for grinding was therefore greater for the larger size of motor. Since the windage and friction losses increase rapidly at the higher speeds,











PERFORMANCE CURVES

Fig. 2 Effect of mill speed on efficiency, 10x4-in hammer mill, ½-hp motor, gross and net power requirements for shelled corn and oats. Fig. 3 Effect of mill speed on fineness for same mill, motor, and material ground. Fig. 4 Effect of fan on mill efficiency for same motor, mill, and mill speed of 3570 rpm. Fig. 5 Effect of mill width on efficiency for same motor, mill speed, and material ground. Fig. 6 Effect of number of hammers on mill efficiency, same motor and mill speed, for 10x4-in hammer mill

it is essential that these losses be considered carefully when determining the most suitable operating speeds.

On Fig. 2 is shown the effect of speed on efficiency when grinding oats and when grinding corn. The gross power is the total power input to the motor. The net power is that used for grinding only, and was obtained by subtracting from the gross power the power required to run the mill empty. The grinding efficiency increases with an increase in speed as indicated by the power requirement curves. The increase in efficiency of grinding is more pronounced on the 3/32-in and finer screens than on screens with larger perforations. Since windage and friction losses increase more rapidly beyond a certain speed than does grinding efficiency, the net result is a loss in overall efficiency at the higher speeds.

Fig. 3 shows the results of change in speed on fineness of grinding. In every case, the higher the speed the finer the grinding obtained when using any given screen.

Fig. 4 gives the power requirements of the 4-in mill, both with and without fan. When material was being ground finer than about 3.00 fineness modulus, the mill with fan attached was more efficient, but for coarser grinding the fan was a definite disadvantage, requiring power for its operation without increasing capacity or improving performance. Since a large proportion of grinding for feed is coarser than 3.00 fineness modulus, a fan was considered unnecessary. No difficulty was experienced with screens becoming clogged, due to absence of a fan, when the mill was constructed so that the ground material was free to drop away from the screen into a sack or feed bin. Obstructions, shoulders, and projections were avoided in the design of the mill.

A comparison of the two mills on the basis of mill width indicated the superiority of the 4-in mill. In addition to possibly higher efficiency, this mill was more to be desired because of its mechanical sturdiness and greater accessibility. The curves of comparison when using a ½-hp motor are shown in Fig. 5.

The effect of number of hammers on mill efficiency is shown in Fig. 6. The number of hammers used was changed from 4 to 8, then to 12, and the results noted. The greater number of hammers was definitely more effective when grinding oats and equally effective when grinding corn. This was not indicated, however, when grinding barley.

As a result of the foregoing tests the following general conclusions on small hammer mills were drawn:

1 For satisfactory operation of a small capacity hammer mill, a fan is not necessary, and for general grinding no considerable gain in capacity or efficiency is obtained by use of a fan.

2 The most satisfactory speed for grinding with a hammer mill of the type used here, and having 10-in swing, is about 3750 rpm. This most desirable speed depends somewhat on the material being ground and on the fineness of grinding desired. The lighter the material and the finer the grinding, the greater the desired speed.

3 A mill 4 in wide is preferable to a mill 2 in wide when using either a ½-hp or 1-hp motor, because of more satisfactory operation, greater mechanical stability, and better accessibility.

4 Finer grinding is obtained for given material and conditions with finer screen, higher speed, and greater number of hammers.

5 To be satisfactory, any small grinder must be at least semi-automatic in operation.

THE SEMI-AUTOMATIC HAMMER MILL

Based on the general conclusions just given and on the tests made with these small grinders, a small hammer mill has been developed. This mill is 4 in wide, with 11-in swing, and is of the conventional swing-hammer type, with 10 hammers. The hammers are suspended on rods passing through circular disks. The disks are clamped on the mill shaft, which in turn is carried by two double-row, self-aligning ball bearings. The mill has semi-automatic tangential feed. The screen, which is semi-circular, thus giving 180 deg of screen arc, is readily replaceable. The mill may be belt driven, or it may be direct connected to a 3600-rpm, ½ to 1-hp motor.

The use of any feed grinder for quantity grinding with a motor of 1 hp or less can hardly be justified where constant attendance is required to insure operation. In order that any mill which grinds comparatively slowly be practical for quantity grinding, it is necessary that it be suitable for operation without the attention of an operator. One of the essentials for a mill for semi-automatic operation is uniform feeding. An open feed throat is necessary to prevent overloading the motor while utilizing its full capacity, and to eliminate clogging of the feeding device.

The Feeding Mechanism. Many different methods of feeding the material into the mill have been tried. The automatic feed developed to date is of especial interest because of its simplicity, effectiveness, and ease of control. It eliminates the necessity of a full-time attendant, having operated for several hours at a time without attention. This automatic feeding mechanism consists essentially of a vibrating feed table, table supports, drive belt, off-balance pulley, and shaft. The pulley and shaft are free running. The material being ground, which may be oats, shelled corn, or any of the small grains, is fed onto the feeder table by a spout from the storage bin, and due to the vibratory motion of the table, is carried at a uniform rate into the grinding compartment. The vibratory motion is imparted to the table by the free-running, circular, off-balance pulley. The direction of vibration of the table is determined by the table supports which are four ⅛-in rods attached rigidly at both ends. The table is thus "floating" on four small flexible supports. The amplitude of vibration required is very small and is not at all critical. The rate of feeding is controlled principally by regulating the amplitude of vibration of the feed table. The direction of table vibration is perpendicular to the wire supports, with no appreciable component parallel to the wire. This vibration causes the grain to move uniformly along the smooth surface of the feed table in a series of slight pitching motions, even when the table is inclined as much as 20 deg upward from the horizontal. The rate of feeding is controlled by the current demand of the motor. This is accomplished by means of a solenoid in series with the motor. This solenoid is attached to a control lever, which engages the shaft bearing of the vibrating pulley when the motor becomes fully loaded, and thus reduces the amplitude of vibration of the feed table. Should the motor become overloaded for any reason the control lever is brought to bear more heavily on the shaft bearing, and thus stops any appreciable vibration of the feeder.

When it is not desired to include the solenoid in the mill construction, as would be the case were the mill to be driven by a small gasoline engine, the feed table is constructed so that it may be adjusted as to angle of incline, thus manually regulating the rate of feeding. When the mill is driven by a small gasoline engine the solenoid control is not necessary for automatic control of rate of feeding. As the load on the engine increases, the speed decreases, and the speed of the off-balance pulley drops to the point where the feed table stops the vibration necessary for feeding. On actual test the speed did not drop sufficiently to entirely stop the feeding, but a speed of equilibrium was reached and automatically maintained where the rate of feed was just enough to keep the engine loaded. However, the use of a gasoline engine for power necessitates safety provisions, to minimize the fire hazard always present with use of power units using inflammable liquids as fuels. This is of course an inconvenience, and often an added expense when feed grinding is to be done in the barn.

CONCLUSION

In addition to grinding oats and shelled corn, these hammer mills have been used for grinding barley and other small grains for stock feed. Test runs were also made as to the practicability of *(Continued on page 450)*

Farm Experience in Forage Curing

By Howard T. Greene

THE FARMER today has a greater choice of methods of curing forage than in the past, namely, (1) the accepted method of natural field curing, (2) artificial drying of forage, and (3) putting green forage in silos for natural fermentation, with addition of molasses, or by the AIV or acid method of forage curing. Several other methods of using the silo as a means of storage are in the experimental stage, but have not been put to commercial use.

All of these processes are becoming more and more linked to our newer knowledge of nutrition. Every year is showing that the fresh, green crop has nutritive values that cannot be overestimated, and the search for means of curing forage in the most natural state is continuing. It is my belief that milk in the future will be graded to a much greater extent on its nutritive value, rather than on its purely sanitary value.

In our experience we have used all methods of curing forage named above. We believe that a combination of all methods is probably the most economic in large-scale farming. In small-scale farming, the use of the present-day accepted methods of field drying, plus the various methods of putting up silage, are probably extensive enough.

Except under absolutely ideal weather conditions, it is difficult to field cure hay or forage so as to insure a maximum nutritive value.

The artificial drying of hay is particularly expensive from the point of view of initial investment. The operating costs of hay driers today, when the factors of fuel, power, and labor are considered, are not prohibitive, and in most cases are covered by the additional value of the crop and the additional tonnage secured from the field.

Our experience in the ensiling of crops is that the natural fermentation process is only applicable to corn or to other crops carrying a fair sugar content. The molasses method is comparatively simple, and molasses is available in many parts of the country at an economical price. It does demand care in filling and a sufficient amount of molasses. The poor results reported by some are undoubtedly due to a deficiency of molasses.

The AIV or acid method has been very satisfactory in our experience and certainly from the point of view of the finished product, ranks with the artificial drying of hay. The use of AIV silage in a dairy herd does result in a milk of greatly enhanced color and undoubtedly a higher vitamin A content, with a high potency in the newly discovered growth-promoting-factor. So far, our experience has been that this method is the most reliable in the preservation of the biological nutrients. Our practical men operating the cropping department feel that the use of acid, even on corn silage, is worth the additional cost.

In relative costs of materials used, the molasses method is probably most economical in most parts of the country, but where molasses has to be bought in barrels, this method is as costly as either artificial drying or the AIV method. Artificial drying of hay necessitates a cash outlay for fuel and power of probably \$2.50 to \$3.00 a ton. The AIV method runs from \$2.00 to \$3.00 per ton on a dry basis.

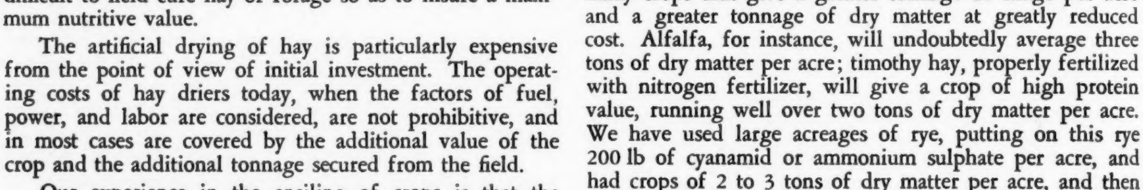
I want to point out here the need for new machinery to handle crops for forage curing under the new method. New machinery is being developed, but rather slowly, and the need exists for handling a large tonnage per day at as low a cost as possible.

In this connection, there is a possibility of quite a change in agricultural crop practices throughout the northern third of the corn belt. I am speaking of that part of the corn belt where corn is grown primarily for silage. Our figures show that an acre of corn 8 ft high produces approximately 8 tons of corn silage. On a dry basis this is not much over 2 tons of dry matter per acre. There are many crops that give a greater tonnage of silage per acre and a greater tonnage of dry matter at greatly reduced cost. Alfalfa, for instance, will undoubtedly average three tons of dry matter per acre; timothy hay, properly fertilized with nitrogen fertilizer, will give a crop of high protein value, running well over two tons of dry matter per acre. We have used large acreages of rye, putting on this rye 200 lb of cyanamid or ammonium sulphate per acre, and had crops of 2 to 3 tons of dry matter per acre, and then have been able to plow this land again for an additional forage crop the same year. This lowers the field operation cost tremendously as there is not the everlasting cultivation coming at a busy time of year.

An interesting side development of this same idea is the possibility of eliminating a great deal of grain from a dairy cow's ration by growing succulent young crops, fertilizing them heavily so as to have a high nitrogen content, and cutting at a very early stage. It is quite likely the hay drier would be of most value in the conservation of this type of crop as Kentucky blue grass or June grass have shown analyses as high as 30 per cent protein when cut almost at the lawn-mower stage. In parts of the country several of the cereals can be cut young, dried, and have a feeding value quite comparable to high protein grain. No machinery as far as I know has been adapted to the cutting and harvesting of this type of crop. This is an agricultural engineer's problem.

Presented before the Power and Machinery Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 24, 1937.

Author: Manager, Brook Hill Farms (Wisconsin).



Farm Machinery Problems in Erosion Control

By G. E. Ryerson

THE existence of very definite problems in the use of farm machinery, brought about by the adoption of erosion-control practices, is recognized by both the implement and erosion-control engineers. The importance of this problem cannot be overemphasized, and can be fully realized only when we consider the importance of the erosion-control work now being carried on and the necessity for a more widespread adoption of erosion-control measures.

Farming is a competitive business, like any other, and all farmers are vitally concerned with the efficiency with which the necessary farm operations can be accomplished. If the restrictions placed on the methods of using farm machinery to bring about a more effective control of erosion reduce the efficiency with which the normal farm operations are carried out, the farmer who follows the recommended practices is working under a handicap. He must either expend more effort to accomplish the same thing his neighbor does, or he must be content with a smaller comparative income. It is true that he undoubtedly would get a larger income over a period of years, but unfortunately there are many farmers who have such a large fixed expense that it is impossible for them to take any reduction in their present income, if they can help it. It is equally true that many farmers cannot work any harder.

This reduction in efficiency is probably not serious enough on the steeper or poorer agricultural areas to retard, to any great extent, the adoption of erosion-control measures, because erosion is usually so noticeable on these areas that the necessity for control is obvious. In such areas the investment in farm land is not so high that the utmost efficiency in performing the farm operations is required. The equipment used is usually small and consequently may be more readily adapted to working over terraces and in small or irregularly shaped fields.

In the better agricultural areas any reduction in the operating efficiency of farm machinery is more serious. The value of the land is determined not only by the productivity of the land itself, but also because it is possible for one man to till a large area. Full use of the larger types of farm machinery in the most efficient manner has made this possible. The machinery used is not only large but it has been developed to perform its function with a high degree of efficiency, when used in a certain manner. It is on this land that the greatest losses occur when the cultural practices are changed in any way that interferes with the normal operation of machinery. For instance, it is common practice for an Illinois farmer to cultivate his corn with equipment costing close to $1,000. At least as much time is consumed in making turns and passing each impediment with this equipment as is used by the southern negro with a mule and walking cultivator. In each minute of operation the Illinois farmer will cultivate approximately eight times as much corn and each minute lost is that much more serious to him. Besides this, there is the difference in wage scales and interest on investment, both of which further penalize the Illinois farmer for wasting time.

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Author: Agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. Assoc. Mem. ASAE.

It is easy to sell erosion-control work in an area where erosion is serious and where it is obvious that a continuance of the present practices will lead to destruction, regardless of the severity of the necessary control practices, but it is an entirely different matter in areas that have not as yet been severely damaged. Even if convinced of the importance of protecting his land against future damage, the farmer is likely to be inclined to risk what he has not as yet experienced, rather than to put up with loss of time and inconveniences in the operation of his farm machinery, unless it is possible for him to protect his land at no great yearly expense or inconvenience. The annual expense involved is probably more important to the farmer than the original cost of setting up the erosion-control practices.

In spite of the importance and magnitude of this problem, very little has been done either toward finding a solution or toward determining its seriousness. Observations have been made of the difficulties encountered in operating the various implements on terraced land, but most of the records are incomplete in that they tell only of specific cases of trouble. In most of the records the terrace cross section on which the trouble occurred is not shown. There is usually little information as to how the implement was used, and even less about the implement itself. There is no information available as to how widespread or how troublesome each specific difficulty is. No study has been made to determine how the various erosion-control practices affect the time required to perform the necessary farm operation. The problem is infinitely more complex than the mechanical difficulties involved in operating an implement over a terrace ridge. As far as the individual farmer is concerned, erosion-control practices affect the operation of farm machinery in only two ways, the time required to do the job, and the quality of the work done. The time element is undoubtedly the more important of the two.

Terraces are not alone in bringing about an increase in the time required and a reduction in the quality of the work done. Contour cultivation is responsible for side slippage, so troublesome in potato machinery and in the cultivation of row crops. It also causes a large increase in the number of rows and produces irregularly shaped fields. Where large fields are prevalent, strip cropping materially reduces the size of the fields and always increases the length of field boundaries in proportion to the area. Farmers are well aware that any increase in the number of rows, regardless of whether they are point rows or full length ones, will greatly increase the time required to work a given area. Also that any substantial increase in the border-area proportion will both increase the time required and decrease the quality of the work done, especially in harvesting small grain. Various combinations of terracing and strip cropping are used to eliminate point rows, but unfortunately all of these systems provide the greatest amount of protection at points where it is least needed, and while the point-row problem is solved, other problems are introduced which may be as serious as the presence of point rows.

Numerous recommendations have been made for changes in the design of farm machinery, most of which are for an increase in the flexibility of the implement so it will conform more closely to the ground surface on all parts of the terrace. Greater flexibility in the larger implements would undoubtedly be very beneficial, but such a

change should not be held forth as a panacea for all the problems involved in the operation of farm machinery over terraced land. Such a change would make possible an improvement in the quality of the work done on terraced land, and probably would bring about some small saving in time. A more flexible machine could not, however, be turned any more quickly at the end of point rows. It would be just as awkward in small irregular fields and would be just as susceptible to slipping sideways. The production of such equipment would involve much more from the manufacturers' standpoint than merely designing and building it.

We need to determine how the practices recommended affect the operation of farm machinery, as well as how they affect erosion. It is quite possible that the cost of some of the practices approaches, under some conditions, the value of the benefits derived from them. In other cases, more efficient methods of using the available equipment, that will give the necessary protection against erosion, can undoubtedly be developed. The older and more cumbersome types of machinery are operated under an even greater handicap on terraced and strip-cropped fields than they are in a straight-row farming system. There is much to be learned about the types of equipment that can be used most efficiently in the manner necessary to control erosion. Erosion-control practices have accentuated the importance of readjustments in the use of some farm implements, and have created a need for adaptability to the job that has not existed heretofore. The significance of these adjustments between the various farm implements is neither understood nor appreciated, but it is possible that they may be the key to reducing the cost of controlling erosion to a point that it can no longer be considered a burden, even by large-scale farmers.

Terrace maintenance is one of the most acute problems in farming terraced land. The erosion-control engineers in the various regions have developed the best methods by which this can be done with the plows commonly used in their regions. Two-way plows seem to have very definite advantages for terrace maintenance, if used to turn the furrow slice up both the slope of the field and the slope of the terrace. Terraces so maintained could be reshaped to any desired cross section. The broadening that would be brought about by the regular plowing could be great enough to eliminate most of the difficulties incidental to the operation of grain binders, combines, drills, etc., over terraces.

The two-way plow, if properly used, would counteract practically all of the movement of soil down the slope, as well as maintain the terraces. There is evidence that this will obviate the necessity of contour cultivation of row crops on gently sloping terraced fields. If contour cultivation of row crops was found to be unnecessary under these conditions, the cultivation of these crops would be very much simplified.

Tractor-mounted implements have many characteristics, such as maneuverability and stability, or resistance to side slippage, that make them particularly well adapted for use on terraced fields. If equipped with power lifts, they will also aid in the preservation of terrace outlets and grass waterways. The possibilities of this type of farm equipment for use in erosion-control work are not fully appreciated.

I have attempted to stress both the importance and the size of the problem indicated. It is broad because it includes working out methods by which erosion-control work can be carried out without placing a burden on any farmer who wishes to do it. This will involve a complete utilization of the available machinery to the best advantage, and a gradual development of the most adaptable types so that they will meet the new operating conditions even better. The future development of erosion-control work depends largely on the development of a practical solution of this problem. Before a solution can be attempted we must determine the working characteristics of all the available types of farm machinery and the requirements which they must fulfill. After that is done we can begin to put the two together and work out the most desirable combination of methods and implements for each set of conditions.

Information is now being collected throughout the corn belt, which, it is hoped, will serve as the groundwork for further development of a solution.

This problem is so large that the thought and consideration of all of us, as agricultural engineers, will be required before it can be satisfactorily solved.

Design and Performance of a Small Automatic Hammer Mill

(Continued from page 447)

grinding several other materials such as soy beans, cane seed, lespedeza seed screenings, tankage, and oyster shells for chicken mash. The grinding of corn meal and whole wheat flour for use in the home was also tried and the results were favorable. No trouble was experienced with clogged screens.

While these small hammer mills do not have as high efficiencies as do large grinding units, their efficiency has been shown to be equal to any other type mill of equal capacity and power. The advantages of a small investment grinder to the farmer who can use this size would probably more than offset the lower efficiency due to lower capacity. Such mills can be driven by low-power electric motors, or by small single-cylinder gasoline engines such as many farmers now own. The automatic feeder and electromagnetic load control heretofore described eliminate the most serious disadvantage of the small grinder, thus making it practical for the farmer to utilize a low-capacity, low-power grinder for a variety of needs. Even though these small mills are referred to as low-capacity grinders, they will grind enough small grain for a dairy herd during the time required for milking. Thus the ground feed is always fresh, and there is no danger of feed loss because of spoiled feed.

Designs and drawings have been made of a new low-power hammer mill to meet the needs of those who can use such a grinder to advantage. This mill has been constructed and is now being tested. This mill is 4 in wide, has 11-in swing, tangential feed with automatic control, and is intended for operation at 3450 rpm. It is hoped that this mill will perform with even greater satisfaction than those heretofore tested.

AUTHOR'S NOTE: The author wishes to express his appreciation for the assistance and cooperation of all those who were associated with him in this work, especially to George W. Kable for his suggestions and for the opportunity of carrying on the work, to S. M. Beane for certain preliminary tests and data, and to W. C. Gillham for much of the experimental data from which this report has been taken. The author also appreciates the cooperation of the O. B. Wise Pulverizer Company, of Knoxville, Tennessee, who provided some of the hammer mills used in this work.

Educational Programs for Rural Electrification

· By Albert V. Krewatch

WITH OVER one million farms receiving "high line" electricity and over 100,000 of these getting it for the first time in 1936, the need for speeding up and expanding the educational program in rural electrification is evident. The problems of how best to aid the largest possible number of families in rural areas to achieve better living through getting electricity, are many and are varying constantly. We can help with successful educational programs that will reach and be adaptable to people of various circumstances and interests. These programs should be designed to interest the entire family. They should meet the people's present demands for information, and should stimulate their thought toward a fuller use of electricity in their homes and on their farms.

Federal agricultural programs have led many thousands of people into the sphere of cooperation and the advantages to be obtained by cooperating with agricultural extension service agents, because it has always been the aim of the extension service of the United States, made up of the services in the various states and the county and home demonstration agents, to strive for a richer life for the rural population. To attain this goal, the problem has been attacked by educational means along different lines, ranging from problems of production to those of an economic nature and to recreation. In volunteer educational programs only those of higher intelligence or higher ambition responded. With the rural electrification program, however, it has been possible to reach the so-called lower levels of farmers along with the aggressive groups. Emergency programs of the federal government, such as the AAA, have already enabled the extension service to make contact with these families.

With the present rural electrification program both material and educational assistance is being given farmers. Merchants, and even industrialists and laborers are being benefited. It is important, then, that we continue to develop our educational program to reach and assist a greater number of the less aggressive, less fortunate groups, along with the more ambitious and fortunate, because the paying out of projects and line extensions will be greatly assisted; the continuing liberalization of line-extension policies will be dependent in part upon our accomplishments, and, from the farmer's point of view, reductions in rural rates will follow the general acceptance of an educational program as shown by increased use of electricity.

All of our rural people are interested in how to get electricity, how to use it, and how to get the most out of it. They are interested, also, in costs, planning for electricity or wiring, principles of good lighting, how to care for and handle electricity so it will be safe, and how to make minor repairs.

A Rural Women's Program. We have approximately 10,000 rural women cooperating with the extension service. They are organized in county and district groups. In the fall of 1936, we developed lighting demonstration equipment and prepared material for use at demonstrations for these groups. Thirty-eight meetings were held in eleven counties. These meetings, along with the community meetings handled jointly by the home demonstration agent and the utility service workers, were attended by over 4,000 persons.

In most instances, a demonstration or school was held for the club leaders in a county, some counties having 10 to 12 leaders, others 25 to 30. Then each leader held a community meeting at which the specialist or commercial representative would assist with the demonstration. Later we held district and county-wide demonstrations, discussing lighting as well as other general problems, and as a result, lighting has been improved in many homes, surveys for projects were started, area work speeded up, or short line extensions hanging fire for years, were organized and have been built.

The reports of the home demonstration agents show improvement in lighting, better shading of bare lamps, adequate light, not only on high line service, but from farm plant service and even oil lamps. The same fundamental principles of good lighting apply and we included these items in our presentation, because many attending did not have "high line" electric service. It was necessary to picture and demonstrate the reasons for good lighting, how it can be accomplished with a minimum of expense, and how it can be tied in with arrangement of furniture and equipment for better family living. In some counties, the home demonstration agent has followed principles of lighting with furniture and lighting arrangements; study of types of lamps, including oil; lamp clinics; and repair and safety, wiring and planning, and cost of electricity.

Such educational programs will be a factor in making leaner areas feasible for electrification. As the program continues, we should reach about 20,000, or 50 per cent of our rural Maryland families.

Each summer between 700 and 800 rural women attend our annual rural women's short course at the Maryland State University. This short course is conducted by the home demonstration division of the extension service, and includes, among various courses such as music appreciation, home furnishing, food and nutrition, clothing, parliamentary law, landscape gardening, child development, rural sociology, and poultry, a home management course, in which good home lighting, trends in home plans, care and safety, costs of electricity, rates, and extension policies are taken up. The short course is worked out on a four-year plan and we feel is a splendid opportunity for our rural women. It is so popular that a waiting list and county limits have been in effect for the past few years.

Our men's program consists of general meetings, in most cases tied in with a series of farm bureau meetings, or group meetings of new signers for electricity. Wiring motors, and farm applications are discussed. Our 4-H electrical club work is based on a definite one-year program for each club, and is to be followed by special project work during the following years. .

Keeping Up with New Extensions. One of the cooperative features of a well developed educational program is to have the utility keep the local county agents and home demonstration agents informed as to the approval of

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Author: Specialist in agricultural engineering, agricultural extension service, University of Maryland. Assoc. Mem. ASAE.

new line extensions for construction. We are asking our agents to keep in close touch with those extensions, send out suitable literature, and hold meetings and demonstrations. If the extension is short, correspondence and personal contact usually takes care of the needs. If sufficiently large, information on wiring, lighting, equipment, and costs is given in the form of meetings and demonstrations.

In Delaware, this past spring, we distributed survey sheets at one of the meetings and had those attending check the equipment about which they would like to receive information. The agents later prepared general letters and sent them to the individuals. With well prepared material in the county agents' hands, this service should be appreciated by the rural people.

Literature. The program in general will make use of every educational means such as literature, circular letters, group meetings, schools, short courses and demonstrations.

Our educational literature for general distribution has been prepared for the use of the less aggressive group. We have prepared five mimeograph circulars for this purpose. Technical and tabulated information has been reduced to a minimum, with the hope that this less aggressive group will make use of the material prepared, or at least give some thought to the problem. More complete material is available for the leaders and aggressive farmers who will make use of it.

It is desirable that the literature used be kept within the interest range of the people to whom it is presented, especially in programs such as planning for electricity, wiring, and lighting. One of the best things we can do in carrying out a program is to direct the individual to recommended cooperating services, such as rural service men or women of the local utility, the cooperative project, or commercial organizations.

Circular letters are useful in connection with projects and groups of short-line extensions. One-page letters can be prepared on individual pieces of equipment, pointing out important considerations before purchasing, and sent to those asking for the information, or to those designating the piece of equipment on their survey sheets.

Short Course. Rural electrification is just one of the many phases of educational work carried on by the extension service for the betterment of rural people. The county agricultural agents and home demonstration agents are interested in seeing that the economic limit of financing is not exceeded, but that some optimum level is maintained so as to assist the farmer to make a success of his complete farming operations. Then, naturally, he will make a success of his electrification enterprise.

In this program of speeding up rural electrification educational work the conducting of short courses for extension, county, and home demonstration agents, commercial agents, REA projects and utility personnel is an efficient and recommended approach. Each sales agency handling equipment that requires special installation consideration should be in position to assist with its installation. They, as many of them do, should have detailed practical knowledge of applying electricity to farming operations.

County extension agents need all possible assistance because their duties have been increased by emergency programs, and most of them are not familiar with rural electrification to the extent of being able to advise farm people of their counties on the details of applying electricity. Rendering this assistance is one of our most urgent duties at the present time. A number of the larger states are accomplishing this by holding rural electrification short courses. Some states have successfully held schools each year for a number of years and their agents are well informed. In many instances, however, we still have to render individual assistance. Here commercial, project, utility, and extension service agricultural engineers are rendering a service for which there cannot be a substitute at the present time.

The newly-developed utilization section of the REA will render a valuable educational assistance, not only to cooperative projects but to state programs as well. The CREA has already provided valuable material and educational service, because through its efforts the tremendous expense of experimentation has been kept off the shoulders of rural people. While we are accelerating the rate of educational work, we must be efficient, divide our time and responsibilities according to needs, and give special attention to those needs.

To a great extent we are working with fundamentals, educating agents as well as the people. They still need to know fundamentals, just the same as 20 years ago people had to know the fundamentals about the automobile or it wouldn't keep on going. Now most people using automobiles know very little about the fundamentals. In the future we may see the same accomplished for rural electrification. Our rural electricians will know how and will put in adequate wiring. Rural lines will be efficient and render dependable service. Commercial men and field workers will render service. The farmer will use electricity without worrying about what size wire is needed, how to make the equipment work properly, or what to do when he uses more than his minimum bill. He will be considering uses of electricity that are proving successful in his farm management program, as well as those rendering him service and pleasure.

Cost of Electricity. In connection with group programs, I mentioned that people were interested in costs. Most of them in unserved areas have little conception of what a full use of electricity will accomplish. Many have not considered electricity as a substitute for present methods of doing things, and its cost as a partial substitute for present expenses. Most of them appreciate the opportunity of learning costs of operation, first costs, and financing. How the burden can be carried on the family budget is also deserving of much consideration. Home demonstration agents are considering these problems in connection with their club meetings.

Group meetings of both men and women, where costs of operation have been discussed, have assisted greatly in getting them signed up for electricity. Our discussions have centered around present costs, then electric costs, and the amount of use that could be depended upon during the first few years after service is made available. Individual assistance in working out probable usage was necessary. All seasonal uses of electricity are considered on their individual merits, giving due consideration to the type of farming, and the cost of electricity at the particular block in the rate at which the operation falls.

J. H. Bodwell, in a recent issue of CREA News, as just one of the many examples, sets forth a splendid educational approach by a utility to additional use for electricity on the farm. The assistance rendered by such agricultural engineering personnel is a great help to the farmer, to the service, and to the progress of rural electrification. We extension workers realize that group work is to be encouraged, yet there is need for individual assistance that takes both time and personnel, whether it be done by the project, the utility, the commercial concern, or the educational institution. *(Continued on page 454)*

Irrigation as Crop Insurance

By Clive C. Bell

THE PROBLEM of irrigation has been brought forcibly to the attention of the farmers of Wisconsin in the last few years because of the severe drought that has affected a large area of the state. Wisconsin usually receives sufficient rainfall for the growing of ordinary crops in abundance, but of late years this has not been the case. Some of the crops, such as hay, potatoes, strawberries, and garden truck have been practically failures. Irrigation has been given considerable thought and tried out with more or less success. The state has an annual rainfall of about 30 in, which is considered ample for abundant crops if it is distributed throughout the year, without long dry periods during the growing season. The amount of rainfall needed during the growing season of April, May, June, July, August, and September is about 19 in.

The amount of rainfall recorded by the Weather Bureau does not always indicate whether irrigation is needed or not, because the character of the rain has considerable influence on the benefit secured from it. A driving rain, though amounting to one inch or more, has a high percentage of runoff and little penetration on the high land where it is most needed, while a gentle rain of 1/4 in or less does not have volume enough to penetrate sufficiently to be of much value to the plants. It has been found by the farmers that generally there is some period during the growing season when one inch or more of water would be of great benefit and would have a bearing on both the quantity and quality of the crop harvested.

Surface irrigation can be applied on truck gardens in some parts of our territory, and on some crops such as strawberries. The porous hose system is being used some on potatoes and other crops. Satisfactory results are being obtained where the contour of the fields, soil conditions and adequate water supplies are suitable for this type of irrigation. The ideal soil for porous hose irrigation is a sand or sandy loam with a heavy subsoil about 16 in below the surface. It should not be used on a heavy clay soil.

We have found this system to be lower in first cost but higher in operating costs than the other systems. It is also limited to the smaller fields. However, we have had very satisfactory results from it.

Due to the contour of the land and the texture of the soil there is no subirrigation being used in our territory.

Both the stationary and the portable types of overhead irrigation systems are being used in our territory. We have found that the stationary type adapts itself favorably to smaller tracts of land, such as nurseries and truck gardens, while the portable systems work well on both small and large tracts. While the overhead irrigation system has a higher installation cost, the operating cost is appreciably lower.

The stationary system most commonly used consists of parallel lines of pipe about 50 ft apart, supported on rows of posts about 6½ ft high. Each line is equipped with small nozzles spaced from 3 to 4 ft apart. Each nozzle discharges a tiny stream of water perpendicularly to the pipe line, all streams emerging parallel. The water falls upon the ground and plants in tiny drops or as a mist. The entire width of about 50 ft may be irrigated uniformly by turning the pipe. The water is pumped through pipes to the end of each nozzle line at about 35 lb pressure. This system is, of course, not adapted to all kinds of crops, because the posts hinder cultivating the crops and working the land.

The portable overhead system is easily adapted to large tracts of land. The contour of the land is not an obstacle, because of the flexible couplings of the system. The amount of water needed by each particular type of soil, without puddling or caking, can be determined and the necessary amount applied. Due to the ease in taking down and setting up of the portable system, a considerably larger area can be covered per day with less labor and water than are needed for the other systems. Hence the operating costs are lower.

The first irrigation tried in our territory was the surface type of system and was used on about 4 acres of strawberries. The equipment consisted of a 4x6-in, double-action, reciprocating, shallow-well pump, powered by a 2-hp, single-phase motor. The water was obtained from three 2-in driven points and pumped through a 2-in pipe line to one end of the field. There it was distributed to the rows by some old fire hose. Satisfactory results have been obtained with this system for the past three or four years.

A porous hose system in our area is operated by a 3x4-in, two-stage, centrifugal pump with a rated capacity of 350 gpm, operating at 1500 rpm. The water was pumped from a lake and forced through 3000 ft of 4-in pipe line, which had taps every 150 ft. This main line runs through the center of the farm and will furnish sufficient water for four 2-in laterals which extend across the potato field. One-hundred-ft lengths of 2-in porous hose are connected with the laterals for distributing the water in the rows. One man operates this system and moves the hose every 3 hr. Comparing the production of this field with a field of non-irrigated potatoes, it was estimated that the irrigated field produced about 200 bu more per acre.

A portable system was installed on a 100-acre farm with about 50 acres under plow. This system consists of a 4x4-in pump rated at 300 gpm. Water is pumped from a river with a 15-ft lift. A 6-in main pipe line was run through the center of the 50 acres, with taps every 80 ft. The lateral pipe consists of 4-in steel tubing with 15 sprinkler heads. The sprinkler heads are spaced every 40 ft in the lateral. Each head gives a complete coverage on an 80-ft circle and throws 15 gpm of water per head. This gives a double covering on an area 80x600 ft, or about 48,000 sq ft. The 15 heads throw a total of 13,500 gph. Therefore, the 15-head system will lay ½ in of water on 1.1 acre per hour.

With this system one man can disconnect, move to the next tap and connect up the 15-head lateral line in about 25 min, making it possible to lay ½ in of water on about 10 acres per day.

This system was used on several different crops with satisfactory results in each case. An 11-acre meadow

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Presented before the Rural Electric Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 24, 1937. (An abstract)

Author: Rural electrification engineer, Wisconsin Public Service Corporation. Assoc. Mem. ASAE.

which, as a result of the dry weather during the previous year and early spring, looked as though it had been killed out and would produce no hay at all, was given 2 in of water. It immediately showed results and produced 19 tons of hay at the first cutting and 4 tons of second cutting, while the neighbors who had no irrigation systems harvested practically no hay at all.

A field of early potatoes yielded 394 bu per acre with only 49 bu of No. 2s. The late potatoes were damaged by an early frost in August, but yielded about 275 bu per acre, of uniform size, while the average yield of non-irrigated potatoes was 150 to 200 bu per acre.

In preparing the field for potatoes the next year, buckwheat was sowed and given one application of water. In four weeks' time the buckwheat was as high as a man's waist and in blossom. This was plowed under to fertilize the soil.

Although irrigation is new in Wisconsin, it is an established fact that it will pay good dividends on Wisconsin farms where water is available.

Educational Programs for Rural Electrification

(Continued from page 452)

Planning for Electricity. In planning for electricity we consider both wiring and the use and arrangement of equipment. Few rural people, getting electricity for the first time, have any definite plan for equipping themselves for the most economical and efficient use of electricity. I believe it is definitely a part of our job to contact and get information to these people, and with their assistance and suggestions help them lay out some plan for electrification, so that the opportunities of increasing income and reducing labor are considered and provided for at the time of wiring, the equipment to be installed as funds become available. Such assistance should go a long way toward making a thoroughly satisfied family and one that is using electricity enthusiastically.

Planning for adequate wiring is important and is one item that all interested groups should get together on from time to time. I was impressed by reading that 97 per cent of 1,384 homes were wired for a cost not in excess of $25. Covering $3.75 for an entrance switch, and No 8 wire for services up to 200 ft; that under limited load 15 per cent voltage regulation was acceptable; and that with 120-volt lamps in use, no noticeable shortening of lamp life was evident. Such information is making it doubly hard for us to convince people of the need for adequate wiring. Where the use of electricity is definitely limited, limited service may be acceptable. However, there are a few important considerations that should not be lost sight of when planning for electricity.

With a 15 per cent drop in normal line voltage, and 120-volt lamps in use, the user gets a little over one-half the possible amount of light for the money being spent for electricity; a split-phase, ¼-hp motor will use more power, about the equivalent of a 75-watt lamp, to develop full load. From actual experience, occasional farm pump motors during the winter will burn out under low voltage conditions if not protected thermally. Radios will give poor reception unless adjusted from time to time. Non-thermostatic controlled irons will require a longer working time. Toasting will require almost twice as much time, and waffles will not be as crisp as they might. The power bill will be higher than it might have been for service received. These are the expressions of many, are worth consideration, and indicate the need for good voltage regulation, adequate outlets, and large enough wires. We might ask ourselves what provisions should be made for the future, at the time of wiring. Have families given sufficient thought to the future and have they wired economically? Are they in position to add uses in their homes and on their farms in keeping with their farming practices, without changing wiring and with the assurance of continuous well-regulated service? These are some of our problems when discussing uses with farm people.

We have a tremendous responsibility as educational people, and welcome every possible assistance to get adequate information to the thousands getting electricity for the first time, as well as to the thousands that already have it but who may not be using it to their best advantage.

Demonstrations. Demonstrations remain as one of the good ways to get across information. The best demonstration, it seems to me, is one put on by a farmer doing a particular job well; one that fits into his program and that he is enthusiastic about. Visitors can see and feel the success of the application.

This type of demonstration, set up on a county basis or line-extension basis, may do more to stimulate increased use of electricity than we can imagine. Instead of having a complete set of production demonstrations on one farm where many are subordinated, and lose their effectiveness to the actual farmer, we could have these demonstrations on various farms in each county. Expansion of use, it seems to me, has grown from neighborhood contacts rather than from demonstration farms. County publicity and county tours would be one means of getting information to the largest number of people. It will take time to get all practical applications in use in every county, but I believe reward will be found in the results.

Status of Land Drainage in the United States

By John G. Sutton

LAND DRAINAGE is emerging from a long depression. Widespread interest is being shown by drainage officials and farmers in the rehabilitation and proper maintenance of existing drains. Many tile factories are running at capacity, showing increased interest in farm drainage. Some preliminary activity looking towards the formation of additional drainage districts has been observed. These signs of improvement represent a wholesome contrast to the conditions prevalent a few years ago.

At that time many drainage enterprises were delinquent and in a state of bankruptcy. The maintenance of many public drainage works had been neglected for a long period of years. Many open drains had grown up with brush and trees as large as 20 to 30 in in diameter, and had silted up to such an extent that their effective capacity was one-fourth to one-half that required for adequate drainage. Many tile drains were stopped up with silt, or tiles were broken, rendering costly tile systems ineffective. Many outlets of tile drains were blocked by silt in the outlet ditches. When the outlet ditches were cleaned, the silt washed out of numerous tile drains and they became effective again. Many levees had not been maintained, were full of rodent holes, and overgrown with brush and trees so that they could not stand a minor flood. Essential repairs on pumping plants and drainage wells had not been made. To improve these conditions the federal government has extended considerable aid to public drainage enterprises in recent years.

The Reconstruction Finance Corporation was authorized in 1933 to make loans to refinance drainage and irrigation districts in distress. The report of the Drainage, Levee, and Irrigation Division issued March 29, 1937, gives the following summary of its activities to that date, relating to drainage districts:

Number of loans authorized and closed by board of directors, to drainage districts	226
Outstanding indebtedness refunded	$53,682,719
Amount of loans authorized to drainage districts	23,652,475
Number of farms benefited	36,385
Per cent savings effected on annual charges	76

This agency has rendered outstanding and valuable service to the drainage districts which were in distress as a result of the economic depression.

In 1935 the U. S. Bureau of Agricultural Engineering was allotted forty-six CCC camps to work on the rehabilitation and reconstruction of existing drainage improvements. These camps were located in nine states as follows: Delaware, 2; Maryland, 3; Ohio, 9; Indiana, 8; Kentucky, 2; Illinois, 6; Iowa, 5; Missouri, 6, and Louisiana, 5.

This CCC program is limited to the maintenance of public drainage improvements of organized drainage districts and county drains already constructed. New work is not authorized and no swamps are being drained. Work is confined to projects benefiting lands which are unquestionably of high agricultural value when properly drained. Projects which would bring additional lands into cultivation, keep lands of poor fertility or submarginal character in cultivation, or reclaim new farms, are not undertaken. No work is done on private drains.

The work accomplished by the thirty-six drainage camps in the midwestern states from July 1, 1935 through March 31, 1937, was as follows:

1 Clearing 3943 miles of ditches and levees—135,000,000 sq yd, requiring 919,371 enrollee man-days.

2 Excavation work, cleaning ditches and embankment work, strengthening levees, a total of 2341 miles—21,117,000 cu yd, requiring 527,395 enrollee man-days.

3 Relaying and reconditioning public tiles—110 miles, requiring 79,046 man-days.

4 Structures, emergency, flood protection, and other authorized maintenance work—requiring 175,810 man-days.

The estimated commercial value of the rehabilitation work amounted to $7,047,000. Of this amount, $1,411,000 was contributed by local drainage enterprises direct to the projects.

The work of the drainage camps has been greatly facilitated through the cooperation of the county authorities and local people. They furnished draglines and tractors to enable the work to be carried forward efficiently, materials required for structures, and dynamite used in the clearing and excavation of ditches. The cooperation also included personal services and wages of attorneys, engineers, foremen, and skilled laborers employed by the drainage districts and counties on the cooperative projects.

Other federal agencies have been interested in drainage. The Public Works Administration has been empowered to make loans on self-liquidating drainage projects. The Works Progress Administration has engaged in the construction and maintenance of drainage ditches. Its drainage work has been confined, for the most part, to pest and malaria mosquito control. All malaria and mosquito projects are subject to review by the U. S. Public Health Service. The U. S. Bureau of Biological Survey and the U. S. Bureau of Fisheries are interested in land drainage because of its effect on wild life and fish. The Biological Survey program for the rehabilitation of wild life includes the maintenance and restoration of nesting grounds for waterfowl and fur-bearing animals and the protection of food supply and spawning grounds for fish in lakes, rivers and marshes. As a part of this program, the Survey began acquisition of approximately 750,000 acres of land, much of which was drained but which has subsequently proved unprofitable for agriculture. Congress has authorized the Federal Reserve Bank to buy and sell drainage districts' securities. The Farm Credit Administration has secured much valuable data regarding drainage enterprises

Presented before the Soil and Water Conservation Division at the annual meeting of the American Society of Agricultural Engineers at Urbana, Illinois, June 22, 1937.

Author: District engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. ASAE.

to enable careful consideration of loans to farmers on lands lying within such districts.

The size and extent of public drainage enterprises was given in the 1930 drainage census. According to this census there were 84,408,093 acres in public drainage enterprises. There were a total of 67,927 organized drainage enterprises classified as follows: 4,213 drainage districts, 62,707 county drains, 212 township drains, 41 state projects, 68 drainage enterprises in irrigation organizations, 26 commercial developments, 655 individually owned projects, and 5 projects representing other types of organization within thirty-five states reporting drainage enterprises.

The public drainage works completed to January 1, 1930, according to the census, included 138,673 miles of ditches, 55,032 miles of tile drain, 6,540 miles of levee, 444 drainage wells and 292 enterprises in which drainage pumps were located. These totals for the public drainage enterprises are considered substantially correct as of the present time.

The drainage census of 1930 reported 44,500,000 acres of farm land provided with drainage, as compared with 53,000,000 acres reported in the 1920 census. These figures would seem to indicate that many farms reporting drainage in 1920 failed to do so in 1930.

Considerable research and careful study should be given to state laws governing maintenance of public drainage improvements. In general, drainage districts are constructed and maintained, and assessments are spread through special officers elected for that purpose in the case of drainage districts, and through elected county officials in the case of county drains. In several states provision is made for the construction and operation of drainage improvements under both procedures. We have seen that maintenance work in nearly all drainage enterprises was neglected while adverse economic conditions prevailed, and until the federal government gave substantial aid. There was provision in state laws for maintenance, but effective work was not possible because many landowners were opposed to levying taxes for such work, and county and drainage district officials failed to do so. Where such taxes were levied, many difficulties have been encountered in collections, and delinquencies have been large. Inadequate maintenance does not affect all landowners alike within a drainage enterprise. Low lands are affected first and crop losses are larger there than on those even a foot or two higher in elevation.

The ASAE Committee on Land Drainage has made a start by pointing out the legal difficulties and the various methods of legal procedure governing drainage work in different states. The U. S. Bureau of Agricultural Engineering is to undertake a research project covering a study of the state laws governing maintenance and operation of drainage enterprises. This question should receive the active interest and discussion of agricultural engineers, particularly in those states where a considerable part of our best agricultural lands are dependent upon drainage for their successful farming.

A comprehensive research program is needed to determine the relative economy of various methods of maintenance, and to secure reliable data on which to base definite recommendations of proper maintenance practices. The proper design and maintenance of open drains is one of our most important jobs for the drainage engineer. During the last few years we have observed many neglected public ditches. Riding through the flat country, one could observe hundreds of miles of channels overgrown with brush and trees. During a wet spring such as we have experienced this year, in Illinois and states to the east many fields become ponds, farming operations are delayed, and farm profits are reduced.

Through experience gained in the operation of the CCC drainage camps, the engineers of the Bureau of Agricultural Engineering are gaining a new outlook on the importance of careful design and proper construction of drainage channels. The ditch must be adequate in capacity. More research work and additional hydrological data are needed to determine definitely the proper size of ditches, and the runoff to be expected from various types of watersheds, particularly those having flat topography. A well-designed ditch must have stable side slopes. It is believed desirable to follow up construction and reconstruction work, and clean out slides and other obstructions that develop in the first year or two following major cleanout work. It is believed that a cover of grass sod will help stabilize the side slopes of the ditches and reduce maintenance costs. The spoil banks should be leveled through agricultural lands to permit pasturing or cultivation of berms, and to reduce the maintenance costs of ditches. Any pasturing of ditches should be kept under careful control. Stock should be kept off the side slopes when the ground is thawing or when saturated, and hogs should be kept out of ditches at all times.

The proper design and construction of structures is an important factor in protecting existing ditches, and in maintaining proper depth and capacity. Surface water or water from road ditches often enters main ditches with a drop of 4 to 6 ft. If unprotected, a bar of silt will form at such places and partially block the main channel. This may occur rapidly when considerable runoff occurs and the soils are erosive. At such points ditch checks, pipes, or concrete or masonry paving should be provided to prevent local erosion. Substantial headwalls or an iron pipe should be provided at tile outlets to protect the ditch, as well as the tile. It is believed to be economical to collect surface water at a few points by shallow channels on the field side of spoil banks and to reduce the number of outlet structures required. The design and construction of a suitable secondary system for the control of silting may require considerable engineering work and skill.

While it is my judgment that such protective structures will be used more extensively in the future, we must be careful concerning broad recommendations until we have more definite data showing that this method is better and more economical than the method frequently used in the past, of digging a ditch and then redigging it when it fills up and causes enough trouble. One of the most important advantages of a ditch that is maintained with adequate capacity, giving proper drainage continuously, is that crop yields will be more stable over a long period of years, and consequently farm land values will have greater stability.

The proper maintenance and care of levees is also an important problem. Many levees have failed during floods that would probably have stood up had the maintenance not been neglected. Such levees were overgrown with brush and trees, and rodent holes were not kept under control. Such levees are not safe but often give a false sense of security to those farmers whose lands are supposed to be protected by them. It is believed that levees should be covered with a sod of grass wherever practicable, and pastured or mowed regularly. They should be patrolled at regular intervals to guard against rodents.

The main river levees along the major rivers, such as the Illinois and Mississippi, have usually been designed to

withstand probable maximum floods. Many levees along secondary streams are not adequate in height to withstand major floods. This is particularly true where channels are dug in with levees, and are not maintained regularly. An impartial analysis of many projects would reveal that they could be expected to flood at intervals of probably 3 to 25 years. The gradual improvement of such areas, or their abandonment as locations for homes and permanent buildings, deserves careful study. Possibly many of these areas would be more suited to farming under overflow conditions, with frequent flooding expected, than for home sites and permanent buildings.

A properly designed and constructed tile system requires little maintenance. However, there should be an effective organization to permit prompt action when breaks occur and when outlet ditches silt up.

The proper maintenance of drainage pumping plants is particularly important among the pumping districts along the upper Mississippi and Illinois Rivers and in those drainage enterprises depending upon drainage wells. These plants require specialized knowledge and careful management to properly supervise operations.

In appraising the present status of drainage, it is apparent that the benefits derived from the large national development that has taken place far outweighed the disadvantages of a few unsuccessful projects. Probably 90 per cent of drainage enterprises have been successful and are now being wholly or partially farmed.

To realize the benefits of drainage, we must visualize the conditions that existed one hundred years ago. At that time almost the entire northwest quarter of Ohio, the northern half of Indiana, large areas in eastern Illinois, north central Iowa, and the bottom lands along the Missouri, Mississippi, Illinois and Ohio Rivers consisted of marshes, ponds and lakes. Similar conditions existed in many other states. The early settlers were able to cultivate only the higher ridges. Malaria, chills, and fever were prevalent. These swamps have been reclaimed gradually and these areas that were formerly covered with swamps are now some of our best developed agricultural areas, served by cities of considerable size, many towns, villages, railroads, and paved highways.

The National Resources Board in 1934 made the following classification of productivity of all lands in the United States:

Grade 1 — excellent — 101,038,000 acres
Grade 2 — good — 210,935,000 acres

Grade 1 may be described as excellent land for the staple crops climatically adapted to the region in which it lies; Grade 2, good.

An estimate from available information indicates that about one-third of Grade 1 farm lands in the United States are lands in drainage enterprises or lands requiring drainage. Almost one-fourth of the total of Grades 1 and 2 represent drained lands. The importance of these figures cannot be overstated because they indicate that a large proportion of our best agricultural lands are dependent on drainage as a fundamental requirement.

Very little new drainage work has been done during the last decade, due largely to overexpansion of the agricultural industry. However, the National Resources Board estimates that with a 20,000,000 increase in population between 1930 and 1960, and considering the submarginal and marginal lands to be retired, about 55 million acres of new crop land may be needed. In discussing where the additional acres of new crop land can be obtained, the Board states: "Probably 10 million acres or more of land unfit for crops at present will be drained."

It is important that public agencies take an active interest in guiding the selection and development of future drainage projects. In spite of the fact that probably 90 per cent of our drainage enterprises have been successful, those that have failed have caused great economic loss and widespread criticism. The failures in the past should offer a guide for better selection in the future. It is desirable to have new drainage projects reviewed by competent authority, to determine whether it is in the best public interest to develop the land for agriculture, or whether it should be developed for recreational purposes, wild life, or forests. Examinations should indicate that the soils are suitable for agricultural purposes when drained. The plans should be sound from an engineering viewpoint. There should be adequate financial resources to complete the project and to insure maintenance until lands can be cleared, farm drains installed, buildings and improvements constructed, and the project placed on a self-supporting basis. The effect of such developments on public health should also be considered.

In reviewing drainage needs, emphasis should be placed on the desirability of continuing drainage research now under way and of extending inquiry into new fields in which progress is needed. Several specific suggestions have been made, covering research needs, in this paper. In addition to those mentioned, the development of machinery for cleaning small ditches economically is one important subject for additional investigation. The carrying capacities of ditches under different systems of maintenance should be determined. The proper depth of drainage for different crops is a subject on which additional data should be secured. Controlled drainage should be studied. It would seem appropriate for the ASAE Committee on Land Drainage to consider research needs in its work next year.

There are no figures available to show the increase in activity in private drainage work. Many who work in the field of drainage have observed more tile being laid within the last year than during any previous year for a long time. Tile manufacturers report increased business in all sizes of farm drain tile.

One of the most important problems in drainage is educational and extension work among drainage officials and county officials responsible for the maintenance of existing drains. There are approximately 68,000 drainage districts, county drains, and other drainage enterprises in addition to farms drained by individuals. Different drainage commissioners, county commissioners and landowners are interested in each of these enterprises. To keep such a large number of persons informed of progress being made in the field of drainage and to recommend improved practices, is a difficult problem. The agricultural extension services of the state colleges can assist greatly in such work. Several state agricultural colleges have shown considerable interest in drainage extension work. There are now at least four extension men in the Central West who are devoting full time to drainage extension work. Their chief work has been to promote interest among county agents and farmers in the proper maintenance of public and private drains. They have secured and have prepared considerable educational material relating to drainage.

The John Deere Gold Medal

A HUNDRED YEARS after John Deere hammered and hardened a piece of saw blade into plow form, thereby creating the world's first all-steel moldboard, his descendants have made it possible for the American Society of Agricultural Engineers to commemorate his achievement by a fitting award to present-day pioneers who press forward in the furrow he struck a century ago. His descendants are the donors of a fund wherewith the Society is enabled to initiate and endow the John Deere Gold Medal. An informal preliminary announcement was made during the annual meeting of the Society last June, but only now is it possible to show, as illustrated here, the final design of the medal.

In its preparation the sculptor, Julio Kilenyi, was commissioned to develop a design which should stamp in precious and imperishable metal the priceless and permanent contribution of John Deere to American—yes, the world's—agriculture; at the same time to symbolize the advance of industry, the utilization of natural resources, and the evolution of a modern civilization, all of them the consequence of a prosperous and efficient agriculture. This treatment is carried out on the reverse side of the medal.

In the forefront is the pioneer, rifle in hand; his covered wagon carrying his family, his fortune, all the essentials of home and farm in a new, wild land. Slung on the side of the wagon is the irreducible minimum of agriculture, the plow, to be drawn by the patient, plodding oxen which were at once his transport power, his emergency rations, and the nucleus of his future herds. With the rays of the rising sun behind him, eyes turned toward his goal beyond the horizon where the sun should set, his eyes are filled with another light—the confidence that, whatever the soil at the site where he might settle, he will be its master because his plow is of steel that will surely scour.

In the background are symbols of the civilization which in the span of a century have grown from the furrows of his plow—the smoking stacks of factories wherein are formed not only plows, but all the creature comforts of a rich and cultured commonwealth, and the plane which a hundred years after the covered wagon now travels the trail it blazed at a hundred times its pace.

The face of the medal is devoted to the portrait of John Deere, inscribed only with the name of the medal, and the name of the Society by which it will be awarded.

In all the detail of cooperation with the representatives of the Deere descendants in arranging so momentous a matter, the Society acted through its Committee on Medals and Awards. This committee, by the way, comprises the same personnel as when was founded the Cyrus Hall McCormick Medal.

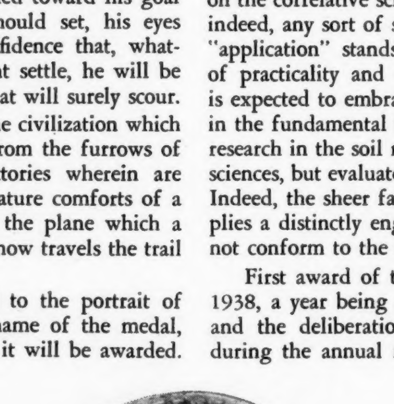
Both medals had their origin at the centennial of the events which they commemorate. Both are the tribute of direct descendants to men great in their contribution to agriculture and to America. Both will be awarded by a jury comprised of the seven immediate past-presidents of the Society. But here a distinction enters. The McCormick medal is to encourage and recognize "Exceptional and Meritorious Engineering Achievement in Agriculture"—limited to engineering, unlimited as to agriculture.

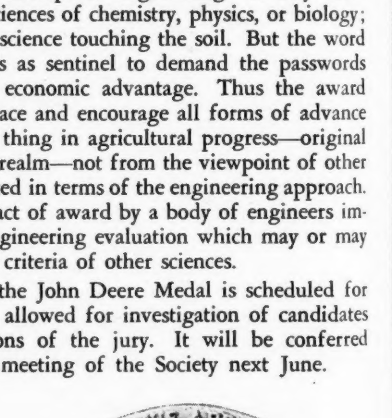
As inscribed around its reverse side, the John Deere Medal is to foster and acclaim "Distinguished Achievement in the Application of Science and Art to the Soil." Thus it is limited to a part of agriculture, less limited as to the type of achievement—a fitting memorial to the man who, though the industry he created grew to embrace every implement of agriculture, nevertheless found its genesis in the single, simple tool, the fundamental of all tillage, the plow; more generically, in the solution of a momentous soil problem.

As thus far envisioned by the Council of the Society and the present Jury of Awards, the scope of achievement contemplated by the inscription is broader than a palpable, merely mechanistic concept of engineering. It may draw on the correlative sciences of chemistry, physics, or biology; indeed, any sort of science touching the soil. But the word "application" stands as sentinel to demand the passwords of practicality and economic advantage. Thus the award is expected to embrace and encourage all forms of advance in the fundamental thing in agricultural progress—original research in the soil realm—not from the viewpoint of other sciences, but evaluated in terms of the engineering approach. Indeed, the sheer fact of award by a body of engineers implies a distinctly engineering evaluation which may or may not conform to the criteria of other sciences.

First award of the John Deere Medal is scheduled for 1938, a year being allowed for investigation of candidates and the deliberations of the jury. It will be conferred during the annual meeting of the Society next June.

The illustrations at the right were made from photographs of the plaster model of the John Deere Gold Medal which is to be awarded by the American Society of Agricultural Engineers for original research and development in the soil realm, not from the viewpoint of other sciences, but evaluated in terms of the engineering approach. The face (obverse side) of the medal is devoted to the portrait of John Deere, the symbolism of the reverse side is described in the accompanying article





NEWS

ASAE Fall Technical Meeting

NOVEMBER 30 and December 1 and 2 are the dates of the fall meeting of the American Society of Agricultural Engineers in Chicago, featuring programs of its four technical divisions. All sessions are scheduled to be held at the Stevens Hotel. Council, executive group, and committee meetings are also scheduled for Monday, November 29, the day preceding opening of the technical sessions.

The Power and Machinery and Farm Structures Divisions are paired off for concurrent sessions on Tuesday, November 30, and Wednesday, December 1. The Rural Electric and Soil and Water Conservation Divisions will meet concurrently on December 1 and 2. Wednesday's full program of four divisions meeting in alternating pairs of sessions is an experiment in meeting popular demand to reduce the duration of the program, and to realize the advantages of drawing together a maximum attendance at one time.

Farm tractor fuels are to be featured in the opening Power and Machinery Division session, following up attention given them at the Society's last annual meeting. Farm transportation problems, including transport wheels and tractor tires, are scheduled for consideration in another session.

A joint session of the Power and Machinery, Soil and Water Conservation, and Rural Electric Divisions is to be devoted to irrigation and irrigation equipment.

Miscellaneous subjects are tentatively slated for the fourth power and machinery session, including force reactions of plows, an engineering analysis of corn production, and 1937 performance of small combines.

A symposium on "The Application of Steel in Farm Structures" is listed for the opening session of the Farm Structures Division. It is to include consideration of zinc coating wire fencing, new uses and methods of applying metal sheets, structural steel units in house construction, and prefabricated steel grain storage units.

"Small Farm House Design" will be treated in another session. One session is to be devoted to forest products research and wood construction. The final session will feature unrelated subjects, including research results on lighting dairy barns, stabilized soil as a building material, and a reinforced crib and granary of structural clay tile.

Highways are to be considered in their relation to land use, erosion control and roadside development in one session of the Soil and Water Conservation Division. Subjects listed for other assemblies of this group include the erosion control problems of railroads, physical and financial aspects of some major drainage districts, conservation districts, adaptability of present tillage machinery to erosion control practices, effect of erosion control practices on trends in farm machinery design, design and construction of the Coshocton in-place lysimeters, engineering and agronomic practices in soil and moisture conservation, cooperative relations between the TVA and state extension services in erosion control programs, and relationship of soils to mechanical erosion control structures.

One session of the Rural Electric Division will feature "An Engineering Analysis of Uses of Electricity in Agriculture."

Other matters to which this Division will give attention include developments in electric fencing, experience with wind electric plants, lighting dairy barns, engineering problems in rural community refrigeration, a program for rural electrification extension, electricity as a farm and community builder, progress of the REA program, and large-scale farm use of electricity.

Evenings are open for scheduling of round table conferences as desired.

As usual there will be no registration fee for attendance at these meetings and interested persons who are not members of the Society will be welcome to sit in with the members attending the technical sessions.

President Yerkes to Address Safety Congress

PRESIDENT Arnold P. Yerkes of the American Society of Agricultural Engineers will be one of the principal speakers before the first farm safety conference of national scope ever planned, which will be held at Kansas City, Missouri, October 11 to 15, during the 26th National Safety Congress and Exposition. The session on agricultural safety will be held Friday, October 15, at which time Mr. Yerkes will address the conference on the subject "Farm Machinery Accidents and Their Prevention."

Civil Service Engineering Examination

ENGINEERS interested in government employment under civil service may obtain detailed information regarding examinations which close October 18 and 21, 1937 by applying to the U. S. Civil Service Board in Washington or to the Post Office or the Customhouse in any city. Completion of a college engineering course in some branch of engineering is required, except for substitution of certain prescribed engineering experience checked by assembled examination.

The American Engineering Council is familiar with the actual need for well trained and thoroughly experienced engineers in federal government service. The staff is in contact with the examiners of Civil Service and knows that Civil Service is anxious to certify engineers of the highest possible qualifications for all positions. It, therefore, is to be hoped that many qualified engineers will take these examinations and thus put themselves in line for consideration as opportunities arise from time to time for work in the several permanent agencies under Civil Service.

Council has been consulted on several occasions by the examiners and believes that while salaries are not what they should be, a large number of engineers may find, in these examinations, the opportunity to begin career service. The salaries listed on the examination notices are the minimum in each instance, and successful candidates may reasonably expect a fair range of increase by gradual promotion. Senior engineers and engineers must be under 53, associates under 45 and assistants under 40.

Washington News Letter

from American Engineering Council

WORKS Progress Administration appears to be the last of the emergency spending agencies created by President Roosevelt in the desperate days of 1933, when the nation turned to public spending on a colossal scale for those things which did not require a market, until the country could develop purchasing power and restore balance to the production structure. Some of the other agencies are still in existence, but WPA is the only one open to applications for projects and in a position to accept additional financial responsibilities. WPA obligations are numerous, but it is still spending at an annual rate of $1,500,000,000.

Engineers have had much to do with CWA, FERA and WPA, and while that organization, under the three names, has been eminently successful in doing what it set out to do—create immediate employment for the heads of relief families—many well informed engineers objected when WPA invaded the construction field on "a force account" basis, and when it relieved the political subdivisions of their architectural and engineering work. As the requirement of 30 per cent local contribution for materials, the $25,000 job limitation, and other restrictions have been forgotten; observers familiar with the practical operation of both the public and the private phases of the construction industry have raised their voices in criticism of WPA engineering and construction policies.

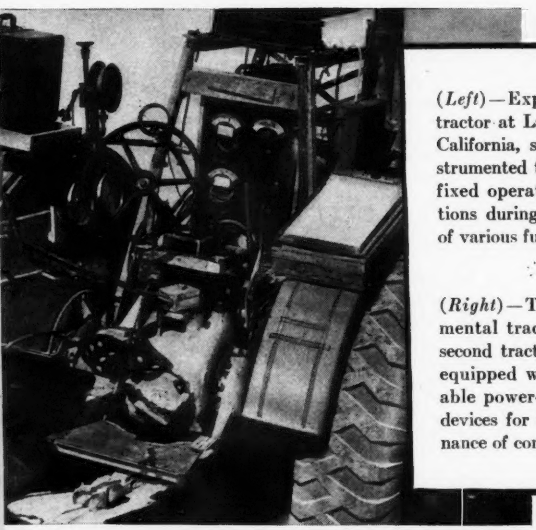
Thanks to the many able engineers employed by the Works Progress Administration, "made work" in the form of "leaf raking" and other "boondogglings" gradually gave way to worthwhile undertakings in many parts of the country. By that time, however, both public and private construction had increased to such an extent that competition for skilled labor began to develop a building and construction trades labor shortage. As a matter of fact, payment of the prevailing wage rates and union labor regulations added much to the confusion, but WPA has neglected to get its case clearly before the public and thus loses credit for much of the good which it has done.

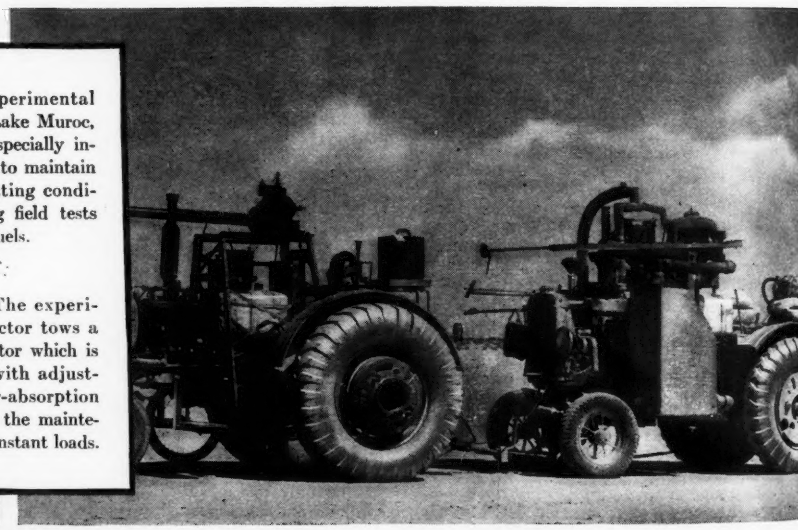
An excellent opportunity seems to be open to the Works Progress Administration to get out of the construction business. That could not be done abruptly, but it might be accomplished in reasonably good time. As rapidly as states and municipalities become able to finance their own construction work, heavy construction could and should return to the less expensive, competitive procedure *(Continued on page 464)*

Because it develops more power, the modern high compression tractor does more work in the same time, or the same work faster.

Whipping u

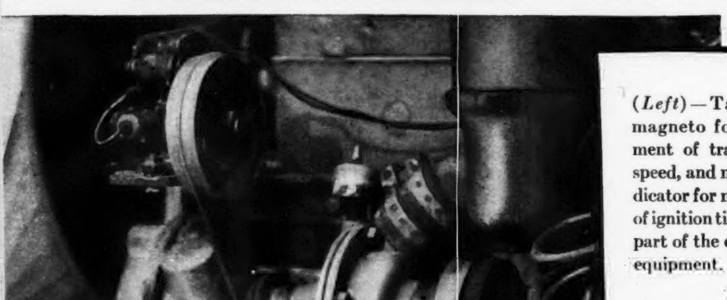
FARMER'S I





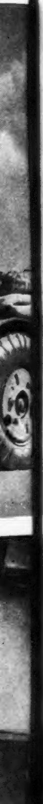
(*Left*)—Experimental tractor at Lake Muroc, California, specially instrumented to maintain fixed operating conditions during field tests of various fuels.

(*Right*)—The experimental tractor tows a second tractor which is equipped with adjustable power-absorption devices for the maintenance of constant loads.



(*Left*)—Tachometer magneto for measurement of tractor engine speed, and neon-tube indicator for measurement of ignition timing are also part of the experimental equipment.

(*Right*)—Cylinder and linkage of drawbar dynamometer used for measurement of load pulled by experimental tractor.



up the IRON HORSE

FOUR YEARS AGO, no farmer could buy a high compression tractor. No manufacturer built one.

Today, nine manufacturers offer high compression tractors in standard models. Two more offer high compression equipment optionally.

The newest high compression tractor has a 6.7 to 1 compression ratio—higher than the 6.25 to 1 average for the 1937 automobile.

"Compromise" engines

Four years ago, the farmer's iron horse faced an unpredictable diet. It might have to burn kerosene, distillate, or gasoline. Consequently, it has been said that the old design was a compromise—so that it could use any of these fuels. Actually, there was little compromise—the engine was designed down to the worst fuel it might get. Its compression ratio was low and its intake manifold was blazing hot. Gasoline in such engines produced little more power than low grade fuels. It *did* have other advantages of causing little or no oil dilution and providing much better warming up, idling, and light-load characteristics.

Possible power increases with gasoline

"Everybody" knew that tractor engines would produce a lot more power on gasoline—if they were designed for gasoline—but for a long time nobody did anything about it. Gasoline has much higher anti-knock value than low-grade fuels, and, therefore, can be used at much higher compression ratios with much higher efficiency. Also, gasoline has much lower vaporizing temperatures than low-grade fuels. Because of this, it can be used with substantially lower intake manifold temperatures—which results in higher volumetric efficiency and still more power.

Improvement in gasoline

However, some tractor engineers were working on the question. They suddenly found their task very much simplified when regular-grade gasoline of uniformly high anti-knock value became generally available in 1934. Gasoline then became a much more uniform product than it had been, and it was so good that its value could not be disregarded. Since then, the development of high efficiency gasoline-burning tractor engines has proceeded at a constantly accelerated pace.

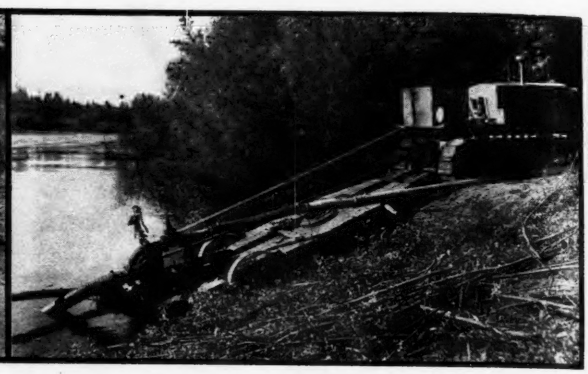
Throughout this research and development, Ethyl Gasoline Corporation's agricultural and research engineers worked closely with tractor companies. They cooperated in their own laboratories, in the engineering departments of tractor companies, and in the field. Such cooperation is part of Ethyl Laboratories' continuous program of improvement of fuels and engines. Ethyl Gasoline Corporation, Chrysler Building, New York, N. Y., manufacturers of anti-knock fluids for regular-grade and premium gasolines.

★ ☆ ☆

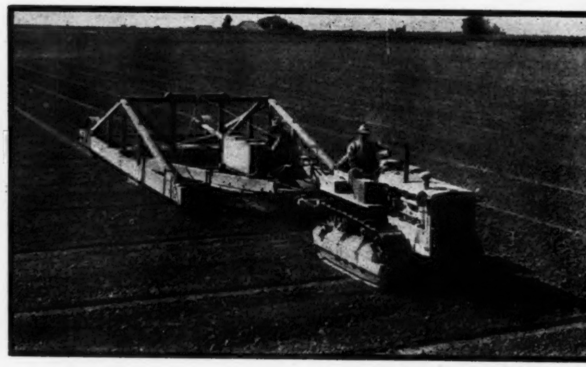
Rain has a rival

IN "CATERPILLAR" DIESEL IRRIGATION!

Building the Reservoir—to impound irrigation water for an orchard of Thomas S. Smith and Sons, Inc., Roodhouse, Illinois. Each "Caterpillar" Diesel D4 Tractor is moving 160 yards of dirt per 8-hour day, on a 300-foot haul—using less than 18 gallons of 8-cent fuel! Saving water in wet spells to keep the fruit crop thriving through summer drouths.



Tractor Pumping—Alderman and Son, Dayton, Oregon, do their heavy land-fitting with "Caterpillar" Diesel Tractors—then profit further by powering their pumps with these tractors. On a 4-inch centrifugal, this tractor is throwing 600 gallons per minute against a 75-foot head—through 3600 feet of overhead sprinkler line. Only 2¼ gallons of 5¢ fuel per hour!



Leveling the Land—on 12¢ worth of fuel, this Diesel D4 floats 3 acres per hour, on the 4000-acre irrigated tomato field of H. P. Garin Company, Brentwood, California. Accurate leveling saves water—promotes uniform yields.

Engine Pumping—lifting 130 feet with a 3-stage pump, this "Caterpillar" D8800 Engine delivers 1200 gallons per minute—at an operating cost (fuel and lubrication) of 29¢ per hour. Owner: Wm. C Vogt, Keensburg, Colorado.

From helping build the dams and ditches on the nation's largest irrigation projects—to building private systems, doing the land-fitting and other field operations and pumping the water—"Caterpillar" Diesel Power brings the irrigator's costs to a record low!

CATERPILLAR TRACTOR CO. PEORIA, ILL.

REG. U. S. PAT. OFF.

WORLD'S LARGEST MANUFACTURER OF DIESEL ENGINES AND TRACK-TYPE TRACTORS

For Highest Efficiency . . Lowest Operating Cost
and 10 TIMES MORE DIESEL SERVICE HOURS

Operators of "Caterpillar" Diesel Engines and Tractors find that use of Sinclair Ten-ol gives them top performance in the heaviest service. Full engine output is maintained and lubrication troubles are practically eliminated.

Ten-ol is a new, fused lubricant developed especially for "Caterpillar" Diesels by the Sinclair Refining Company. Ten-ol prolongs engine life and cuts operating costs. It gives ten times more Diesel service hours than the finest straight mineral oil.

Order Sinclair Ten-ol, Sinclair Diesel fuel, and other Sinclair products from your local Sinclair office or write Sinclair Refining Company (Inc.), 630 Fifth Ave., New York, N. Y.

Sinclair TENOL is recommended as a "new outstanding Diesel engine lubricant" by Caterpillar Tractor Co.

Washington News Letter

(Continued from page 459)

of the construction industry. Even when political subdivisions can only partially finance their work, their applications could be referred to government lending agencies for funds to make it possible to have the work done under normal conditions.

In any event, the questions involved are more local than national in nature, and engineers and engineering organizations will find it relatively easy to approach their home town and state authorities, and most of the administrators of state and local emergency agencies like WPA and PWA, with constructive suggestions. State and local engineering organizations and local sections of national engineering societies may perform a public service of national significance by encouraging local authorities to resume full responsibility for all public construction work in their respective communities. Substitute civic pride in solving local employment and construction problems for the "gimme" attitude for which everyone, for years to come, must ultimately pay a much higher price in the form of both direct and indirect taxation.

* * *

Since it is much easier to secure constructive modification of legislation before passage than to obtain revision afterward, some observers feel that it is for the best that no action was taken on government reorganization in the confusion which attained during the hurried days of the last session of Congress. The delay gives citizens time to investigate the proposed reorganization program and to express their opinions to members of Congress. It also affords an opportunity for the reorganization committees of both Houses to agree upon legislation more likely to effectively serve the purpose. Council, therefore, invites the attention of member societies to the following facts regarding the present status of government reorganization ideas and legislation.

Congress left S.2970 and H.R.7730, H.R.-8276 and H.R.8277 on its calendars as proposals for the reorganization of the Government of the United States. S.2970 was introduced by Senator Byrnes of South Carolina, to reduce resistance to the original proposition for reorganization, after the hearing on S.2700, which had been sponsored by the late Senator Robinson from Arkansas. It was referred to the Select Committee on Government Reorganization in the Senate, which almost immediately reported it back to the Senate without amendment and with the recommendation that it should pass.

H.R.7730, introduced by Robinson of Utah, providing the President with six administrative assistants was reported to and passed by the House without hearings but failed to receive consideration by the Senate. H.R.8202, introduced by Warren of North Carolina, giving reorganization power to the President and creating a Department of Welfare, was reported to the House without a hearing and passed to the Senate where it was referred to the Senate Committee on Reorganization. H.R.8276, introduced by Vinson of Kentucky, creating a general auditing office, and H.R.8277, introduced by Mead of New York, to revamp the Civil Service System, were reported without hearings and left on the calendar of the House at the close of the session. None of the reorganization bills have had consideration by a Joint Committee of the House and Senate, but such a meeting of minds must be had before there can be reorganization.

Copies of the Hearings on Robinson's S.2700, the Report on S.2970 to the Senate by Chairman Byrnes, and Brynes' S.2970 may be obtained by writing to the Select Committee on Government Organization of the United States Senate, Senate Office Building, Washington, D. C. Copies of the bills introduced in the House and the "Remarks by Members of the Select Committee of the House on Government Organization" may be obtained in the same way from the Select Committee on Government Organization of the United States House of Representatives, House Office Building, Washington D. C. A limited number of copies of the reports of the several committees which have studied the situation are also available through the same sources.

Engineers and engineering societies wishing to exercise their rights to advise members of Congress on this vitally important issue should contact members of Congress while they are at home, and indicate their wishes by appropriate resolutions addressed to Senator James F. Byrnes of South Carolina, Representatives John J. Cochran of Missouri and to the members of the House and Senate from their respective states. Council will be glad to have copies of all such communications for the information and guidance of officers, staff, and committees who may be called upon for expressions of engineering opinion by the investigating committees and members of Congress.

* * *

United States Housing Authority became a reality with the signing of the Wagner-Steagall Public Housing Bill by President Roosevelt on September 3, 1937. Numerous amendments were offered and many changes were made during the three years in which legislation for creating the Authority was under consideration. In final form, the Act gives the Secretary of Interior general supervision of the United States Housing Authority, but vests the real power of the Authority in "an Administrator to be appointed by the President by and with the advice and consent of the Senate." The Administrator is to be appointed for a period of five years at a salary of $10,000 and is forbidden to engage in any other business.

A half billion dollars is to be entrusted to the Administrator with very few restrictions. In addition, the President may, at any time within his discretion, transfer to the Authority any right, interest, or title held by any department or agency of the Federal Government in any housing or slum-clearance project, including unexpended balances of funds heretofore allocated for such purposes, and employees engaged in housing or slum-clearance. The Authority may continue any or all activities undertaken in connection with projects thus transferred to it from other agencies. The Authority may also accept and utilize voluntary and uncompensated services of employees of federal, state, and local governments found desirable in the performance of its many duties.

"The Authority, including but not limiting its franchise, capital, reserves, surplus, loans, income, assets and property of any kind, shall be exempt from all taxation now or hereafter imposed by the United States, or by any state, county, municipality, or local taxing authority. Obligations, including interest thereon, issued by public housing agencies in connection with low-rent housing or slum-clearence projects, and the income derived by such agencies from such projects, shall be exempt from all taxation now and hereafter imposed by the United States." As a matter of fact, the United States Housing Authority seems to be all set to do almost anything it wishes to do within exceedingly broad limitations.

Choice of executives for Administrator of the United States Housing Authority seems to rest between three well known authorities on low-cost or low-rent housing and slum-clearance—Mr. Howard A. Gray, director of the Housing Division of PWA, who is believed to be recommended by Secretary Ickes; Nathan Strauss of New York City, who is reported to have the support of Senator Wagner of New York; and John Ihlder, executive officer of the Alley Dwelling Authority of the District of Columbia, who is reported to be Mrs. Roosevelt's "dark horse" candidate. Gray is a mature business executive who has cured the PWA Housing Division of many of its troubles. Strauss is a merchant, banker, and philanthropist who financed the Hillside Housing Corporation in New York City. Ihlder has spent most of his life in civic work and is well known for his housing and slum-clearance activities.

Council has endeavored, through its contacts, to exercise an educational influence to get government housing on a sound business basis, and proposes to cooperate with the new Administrator and staff of the United States Housing Authority as soon as the Authority is ready for business, but Council's staff has refrained from becoming involved in the propaganda and behind-the-scenes struggle for the Administrator's position. In the spirit of helpfulness, however, the following statement was made to President Roosevelt, who has expressed his appreciation for the views of engineering organizations:

"Engineers appreciate the difficulty involved in choosing an Administrator for the United States Housing Authority and wish to assure you of their support in your selection of an experienced executive, for this vitally important position, who is not only technically qualified for such responsibility, but also possessed of sound judgment and practical knowledge developed from dealing with nation-wide business problems of similar nature and magnitude.

"Several branches of the engineering profession in the United States are thoroughly familiar with the housing situation. Many engineers are engaged in public and private housing enterprise, and some are well known authorities on urban planning which involves the elimination of unsafe and insanitary housing conditions. The American Engineering Council is in a position to express the united opinion of a majority of such engineers of this country and will welcome all opportunities to be of service to you and to the Administrator of the United States Housing Authority."

* * *

Building Materials Research is being emphasized with particular reference to low-cost housing, by the U. S. Bureau of Standards, under authority and a grant of $198,000 by the last Congress. The program is being directed by a selected group of experts under the immediate supervision of Dr. H. L. Dryden. A special committee of representatives *(Continued on page 466)*

Washington News Letter

(Continued from page 464)

of government housing agencies, affiliated with the Central Housing Committee, is cooperating with the Bureau and helping to direct the inquiry along practical lines. Chairman Harold D. Hynds of that group states that the nucleus of the program is a coordinated effort to discover suitable "constructions" of low-cost for the important structural and mechanical elements of a house.

An attempt is thus being made to develop a series of laboratory and field tests to determine structural and other essential properties of "methods of construction" instead of making separate determinations, as heretofore, of individual items of material going into construction. The procedure is to examine every sponsored construction within the cost range, in which sponsors have sufficient interest to construct the required specimens for test purposes. In that way, the resources of the entire building material industry may be mobilized with the hope that the results of such performance tests may find their way into building codes. Present building code requirements are usually predicated on conventional methods of construction with standardized items which act as a bar to the orderly introduction of new methods of construction.

The general objective of the work is to furnish government agencies, the building industry and the public with technical information from every available source on the engineering properties of building materials as incorporated in the structural elements and equipment of a house, with particular reference to low-cost housing. It is to include new materials, equipment, and methods of construction as well as those already in use. The program will not deal with sociological, economic, hygienic or esthetic questions or with architectural design. In other words, the Bureau of Standards proposes to help all phases of the building materials and building construction industry as well as public and private housing enterprise without preparing plans or otherwise interfering with architects and engineers in private practice.

A general statement has just been released outlining the objectives, procedure, and scope of the program. It is known as Letter Circular LC502, Research Program on Building Materials and Structures, 1937-38, and may be obtained by writing directly to Dr. H. L. Dryden, Bureau of Standards, Washington, D. C. Since this program is so unique in conception and promises so much to the materials industry and to contractors and builders, as well as citizens who desire small reasonably priced homes, it may prove of much interest to several branches of engineering. In the event that entirely new methods of construction should be proven satisfactory, engineers naturally wish to be among the first to know of the progress.

Personals

Fred W. Knipe who has been serving as agricultural engineer for Seksioni Antimalarik, Tirana, Albania, under the direction of the Rockefeller Foundation, has completed his work there and is being transferred to King Institute, Madras, Guindy, South India.

James C. Lyke has become associated with Starline, Inc., Harvard, Illinois, and will be engaged in the development and design of ventilating equipment and insulation for modern farm structures. More recently he was connected with the U. S. Resettlement Administration.

Charles A. Marsh recently became associated with the farm building department of Wood Conversion Company. His new address is 612 Ruble Avenue, Albert Lea, Minnesota. More recently he was employed as ventilation engineer of the Louden Machinery Company.

Ben D. Moses, associate professor of agricultural engineering, University of California, is on sabbatical leave until January 1, during which time he will be engaged with the General Electric Company at Schenectady, New York, in general rural electrification work.

M. A. Sharp has been appointed head of the agricultural engineering department, University of Tennessee, Knoxville. He was formerly associate professor of agricultural engineering at Iowa State College.

H. N. Stapleton recently joined the Green Mountain Power Corporation at Burlington, Vermont, as agricultural engineer in charge of rural service and company relations, having resigned as extension agricultural engineer of the University of Vermont.

Homer J. Stockwell has been appointed to the extension agricultural engineering staff at the University of Nebraska and began his duties there October 1. More recently he was assistant county agent, specializing in agricultural engineering extension, in Riley County, Kansas.

Necrology

SAMUEL HUME BECKETT, professor of Irrigation Investigations and Practice, University of California, passed away at his mountain home near Kyburz, California on September 17, 1937. The funeral services were held at Davis, California, on September 20. He was born at Garden Grove, California, on September 19, 1883. He had been in ill health since 1933 and off duty since August 16, 1935.

Upon his graduation from the University in 1909 with a bachelor's degree in Civil Engineering, he was employed by the United States Department of Agriculture to conduct research in irrigation in cooperation with the University of California and was stationed at Davis, where he remained until 1930.

In September 1910 he was appointed instructor in irrigation at the Branch of the College of Agriculture, University of California, continuing his connection with the U. S. Department of Agriculture until 1912, when he devoted his full time to University work. His academic rank was advanced from time to time until he was made professor of irrigation investigations and practice and irrigation engineer in 1928. In 1928 he received the Engineering degree from Stanford University.

In 1911 he was married to Miss Lois Mary Plant of Davis. During the World War he was commissioned a First Lieutenant of Engineers and was stationed at Ft. Douglas, Utah. In 1930 he was transferred to the Branch of the College of Agriculture at Riverside and Los Angeles, California, where he had charge of irrigation research and teaching. From 1921 to 1930 he was a member of the American Society of Agricultural Engineers.

HERBERT L. MCCALL, 34, has been reported deceased, no further information being furnished. He was a graduate of Louisiana State University and employed as assistant agricultural engineer, in the Soil Conservation Service, in charge of engineering work in the Ruston Area, under the chief engineer. The family address is 810 East Blvd., Baton Rouge, Louisiana.

ASAE Meetings Program

October 16—Fall meeting, Pacific Coast Section, Asilomar Resort, Pacific Grove, California.

November 29-December 2—Fall meeting of the Power and Machinery Division, Rural Electric Division, Farm Structures Division, and Soil and Water Conservation Division, The Stevens, Chicago, Illinois.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the September issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Charles H. Bailey, laboratory instructor, agricultural engineering department, Alabama Polytechnic Institute, Auburn, Ala. (Mail) Cedar Drive.

Lawrence Collins, consultant in farm management, Collins Agricultural Service, 309 Wilda Building, Denver, Colo.

Donald L. DuBois, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Newberg, Ore.

Kenneth A. Ford, agricultural advertising, Ford, Browne & Mathews, 100 East Ohio St., Chicago, Ill.

H. N. Irvine, draftsman, J. I. Case Co., Racine, Wis. (Mail) 828 Wisconsin St.

H. J. Jensen, tire engineer, Montgomery Ward & Co., 618 W. Chicago Ave., Chicago, Ill.

J. C. McWhorter, graduate assistant, agricultural engineering department, A. & M. College of Texas, College Station, Tex.

R. E. Moore, instructor and soil technologist, University of California, Davis, Calif.

Charles W. Petit, district manager, Soil Conservation Service, U. S. Department of Agriculture, Santa Paula, Calif. (Mail) 1725 Miramar Drive, Ventura, Calif.

Russell R. Poynor, instructor, agricultural engineering department, Utah State Agricultural College, Logan, Utah.

Lawrence H. Skromme, tire engineer, Goodyear Tire & Rubber Co., 1144 E. Market St., Akron, Ohio. (Mail) 1441 League St.

Earl F. Thompson, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 107, Candor, N. Y.

L. J. Waldron, rural service supervisor, New Hampshire Gas & Electric Co., 46 Congress St., Portsmouth, N. H.

Paul A. Whisler, student engineer, Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wis. (Mail) Etters, York Co., Pa.

Agricultural Engineering Digest

A NEW BUHR TYPE FEED MILL, *F. W. Duffee,* CREA News Letter [Chicago], No. 14 (1936), pp. 24-26, fig. 1. In a brief contribution from the Wisconsin Experiment Station a 6-in buhr mill with the main part of the mill a one-piece casting, giving rigidity and simple construction, is described as developed at the station. Service tests have indicated that one-half hour's grinding a day with a 2-hp motor will take care of the grinding for 20 cows.

It has been found that the mill grinds slowly but very cheaply, and can be operated with a motor varying in size from 0.75 to 3 hp. Tabular data on its operation are briefly presented.

RUBBER FOR ROADLESS TRACTORS AND TRAILERS, *A. Hay.* Rubber Growers' Assoc., Rubber and Agr. Ser. Bul. 3 (1936), pp. 13, figs. 11. The use of rubber in the traction mechanisms of track-type tractors is briefly described and illustrated.

THE USES OF RUBBER IN STABLE MANAGEMENT, *A. Hay.* Rubber Growers' Assoc., Rubber and Agr. Ser. Bul. 5 (1936), pp. [1] + 14, figs. 14. Uses of rubber, such as for stall floors and walls, collars, saddles, horseshoes, and stable barrows, are briefly described and illustrated.

POULTRY HOUSE CONSTRUCTION, *F. C. Elford and H. S. Gutteridge.* Canada Dept. Agr. Pub. 506 (1936), pp. 47, figs. 45. This is a revision of a bulletin previously noted.

NEBRASKA TRACTOR TESTS, 1920-1936. Nebraska Sta. Bul. 304 (1937), pp. 38, fig. 1. This bulletin summarizes the results of 87 tractor tests and includes data on all tractors reported on the market on January 1, 1937.

SOIL DEFENSE IN THE PIEDMONT, *E. M. Rowalt.* U. S. Dept. Agr., Farmers' Bul. 1767 (1937), pp. IV + 63, figs. 31. This bulletin deals in a popular manner with erosion of the soil and measures of defense which have proved successful in controlling erosion in that part of the Piedmont country lying in the States of Virginia, Georgia, Alabama, and the Carolinas. Control measures involve terracing, contour tillage, strip cropping, rotation with close-growing crops, and contour furrowing in pastures.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE PENNSYLVANIA STATION. Pennsylvania Sta. Bul. 336 (1936), pp. 17, 18. Progress results are brifly presented of investigations on electric refrigeration on dairy farms by R. U. Blasingame and J. E. Nicholas, stop hitches for tractors and corn and potato production with mechanical power, both by Blasingame and A. W. Clyde, and artificial curing of alfalfa and other forage crops by Clyde and C. O. Cromer.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE CORNELL STATION. [New York] Cornell Sta. Rpt. 1936, pp. 73, 135. The progress results are briefly presented of investigations on milk-cooling equipment by H. W. Riley, B. A. Jennings, and H. J. Brueckner, milk-house construction and equipment by Jennings, Riley, M. W. Nixon, and Brueckner, electric brooding of chicks by F. L. Fairbanks and Brueckner, and air-conditioning in poultry houses by G. O. Hall and Fairbanks.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE CALIFORNIA STATION. California Sta. [Bien.] Rpt. 1935-36, pp. 3-8, 10, 11, 127-132. Progress results are briefly presented of investigations on soil and water conservation, irrigation by portable sprinklers, efficiency of irrigation pumping plants, ethylene treatment and dehydration of walnuts, machinery for lima beans and sugar beets, blowers for frost protection, air cleaner performance, and farm buildings.

PRINCIPLES OF HEATING, VENTILATING, AND AIR CONDITIONING, *A. M. Greene, Jr.* New York: John Wiley & Sons; London: Chapman & Hall, 1936, pp. VII + 446, figs. 254. This handbook contains chapters on methods of application; properties and conditioning of air; loss and gain of heat through walls; radiators, valves, and heat transmission from radiators; method of calculating heat required for rooms; direct steam heating; hot water heating; indirect steam heating, air flow, and gravity systems; indirect steam heating, plenum system, and air conditioning; unit heaters and air conditioning; warm air furnace heating; furnaces, boilers, and heaters; automatic controls; and district heating.

EFFECT OF TREATMENT ON FENCE POSTS, *J. C. Wooley.* Missouri Sta. Bul. 374 (1937), pp. 12, figs. 4. This bulletin presents the results of tests of 21 posts of 27 different varieties of post timber which were begun in 1913. Six different treatments were used, including setting in screened gravel; charring for a distance of 4 ft up from the base; painting with two hot coats of carbolineum; painting with two hot coats of creosote; and submergence in boiling creosote to a depth of 4 ft for 1 hr, followed by submergence in cold creosote to the same depth for 1 hr; and submergence in hot creosote for 2.5 hr, followed by submergence in cold creosote for 2.5 hr.

Setting in screened gravel increased the serviceable life of fence posts 10 per cent, although 22 varieties failed. Some varieties were more favorably affected than others. Honeylocust showed an increase of 100 per cent, red oak 90, and black locust 59 per cent, while white oak, black walnut, and a few other varieties were unfavorably affected by the treatment.

Charring resulted in an increase of 4.4 per cent in the serviceable life of the posts. Black locust showed an increase of 90 per cent and the oaks and walnuts seemed to be unfavorably affected by charring. On the whole the practice did not show sufficient gains to make it worth while.

There was an average increase of 55.4 per cent in the serviceable life of posts painted with carbolineum. The varieties showing the greatest gain from the treatment were honeylocust 218 per cent, red oak 166, hackberry 160, ironwood 160, black oak 131, and black locust 89 per cent.

When painting with creosote, honeylocust showed a gain of 59 per cent, white oak 15 per cent, and other common varieties showed practically no gain from the treatment. Very little penetration was secured with the creosote applied with the brush.

Submergence for an hour each in hot and cold creosote resulted in an average gain in 21 varieties of 10.7 per cent. The gain on the varieties most favorably affected with the percentage gain over the check was willow 300 per cent, black ash 238, red oak 230, ironwood 227, honeylocust 176, river birch 166, hickory 155, cottonwood 150, black walnut 112, and white oak 21 per cent. The real test, however, was not the percentage gain in service but the cost per post-year, and many of these varieties showed too high a post-year cost to be economical.

The average gain in 19 varieties from submergence for 2.5 hr each in hot and cold creosote was 131.3 per cent. The varieties most favorably affected were red oak 300 per cent, willow 312, ironwood 300, black ash 293, hackberry 230, hickory 228, river birch 222, cottonwood 140, honeylocust 135, black walnut 89, and white oak 30 per cent.

It was found that Osage-orange posts are economical without treatment, although they are not well adapted for board fences on account of difficulty of nailing. Catalpa and white cedar posts also proved economical without treatment.

Black locust posts cost slightly less per year without treatment. The cost is about the same for the post year when treated with carbolineum treatment. White oak was found satisfactory without treatment. It was most economical with the carbolineum treatment. Sassafras was found satisfactory without treatment but showed some increase in economy with the carbolineum treatment. White walnut should be given the carbolineum treatment to give sufficient life to be economical. White elm proved economical only when given the carbolineum treatment, and honeylocust was economical only when treated with carbolineum or creosote.

SAVING VIRGINIA SOILS, *L. Carrier et al.* U. S. Dept. Agr., Soil Conserv. Serv., 1936, SCS-MP-16, pp. [1] + 23, figs. 5. This is a popular treatise on soil conservation by terracing, contour tillage, crop rotation, and their erosion and runoff control measures.

WATER SUPPLY FOR ORCHARDS, *B. A. Jennings.* N. Y. State Col. Agr., Cornell Ext. Bul. 367 (1937), pp. 30, figs. 22. Technical information of a practical character is given on storage, pumping, and distribution of water for orchards.

SOIL EROSION CONTROL INVESTIGATIONS AT THE SOUTH CAROLINA STATION, *T. C. Peele, F. Moser, and C. S. Patrick.* South Carolina Sta. Rpt. 1936, pp. 19, 21-23, 62-64, figs. 4. The progress results are briefly presented of investigations in soil erosion control, including studies of water runoff under various cropping systems and terracing. *(Continued on page 476)*

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PNEUMATIC EQUIPMENT FOR FARM TRACTORS, *A. Hay.* Rubber Growers' Assoc., Rubber and Agr. Ser. Bul. 1 (1936), pp. 18, figs. 12. The use of pneumatic tires for tractors used in English farming is described and illustrated.

PNEUMATIC EQUIPMENT FOR HORSE DRAWN VEHICLES, *A. Hay.* Rubber Growers' Assoc., Rubber and Agr. Ser. Bul. 2 (1936), pp. 20, figs. 22. Wagons and carts used on farms in England and equipped with pneumatic tires are described. Tests with carts showed that pneumatic tires permitted the carrying of heavier loads at a saving in time.

REPORT OF COMMITTEE ON ENGINEERING EXPERIMENT STATIONS, ASSOCIATION OF LAND-GRANT COLLEGES AND UNIVERSITIES, AT MEETING OF ENGINEERING SECTION IN HOUSTON, TEXAS, NOVEMBER 1936. Assoc. Land-Grant Cols. and Univs., Engin. Expt. Sta. Rec., 17 (1937), No. 1, pp. 8-12. This report contains statistical data relating to full and part time personnel and funds available at the engineering experiment stations during the fiscal year 1936-37 and funds available at the agricultural experiment stations for engineering research for the same period.

COMPARISON OF RUNOFF AND EROSION IN PRAIRIE, PASTURE, AND CULTIVATED LAND, *J. E. Weaver and W. C. Noll.* Nebr. Univ., Conserv. and Survey Div., Conserv. Dept. Bul. 11 (1935), pp. 37, figs. 11. The results of runoff and erosion measurements from entire watersheds and from runoff plats are presented and discussed.

Enclosed plats 3 ft wide and 33.3 ft long were used in these studies. Natural rainfall was supplemented by artificial watering. Runoff on a 10-deg slope from 26.88 in of rainfall during 15 mo was 2.5 per cent from prairie, 9.1 from overgrazed pasture, and 15.1 per cent from a pasture entirely bared by close grazing. The soil was Carrington silt loam. No measurable amount of soil eroded from the prairie, only a small amount from the pasture, but 5.08 tons per acre were lost from the bare area.

Runoff from 4 in of water applied to pasture and prairie, respectively, in July 1934, at the rate of 2 in per hour (including 1 in applied in 15 min) at intervals 2 weeks apart, resulted in 3.1 and 9.8 per cent runoff. In April of the next year 2.5 in were applied at the same rate to prairie, pasture, and bare area. Runoff losses were 0, 29.3, and 50.4 per cent, respectively, and losses by erosion 0, 165 lb, and 3.42 tons of soil per acre.

In October, after another summer of close grazing and root deterioration, 3 in of water were applied in 1.5 hr to each area. Runoff from prairie, pasture, and bare area was 11.3, 50.5, and 71.6 per cent, respectively, and soil losses from erosion 0, 355 lb. and 4.67 tons per acre. Water penetration was nearly four times as great in prairie as in pasture.

Runoff on a 5-deg slope from 12.9 in of rainfall during a period of 11 mo was 1 per cent from the prairie, 12.1 from wheatfield, and 17.8 per cent from fallow land. The soil was Carrington silt loam. No measurable erosion occurred in prairie, 0.52 ton of soil per acre eroded from the wheat field, and 2.6 tons from the fallow land.

Five in of water were applied to prairie and wheat stubble and 4 in to fallow land during a period of 2 days. Runoff was 3.1, 27.6, and 23.2 per cent, respectively, and soil erosion was 0, 1.29, and 1.75 tons per acre in the same sequence.

Runoff from prairie and young alfalfa on Carrington silt loam with a 5-deg slope during a period of about 7 mo was 3.8 and 19.2 per cent, respectively, from a total rainfall of 10.6 in.

Four in of water applied to each plat in spring when the alfalfa was 5 in tall resulted in 5.9 per cent runoff in prairie and 40.8 per cent in alfalfa. No erosion occurred in the grass land, but 0.72 ton per acre in the field.

Runoff resulting from the application of 3 in of water in 1.5 hr on May 10 on a 7-deg slope on Lancaster sandy loam was nil from burned prairie, but 20 per cent from broken prairie cropped to corn for a period of 6 yr. Topsoil lost by erosion was 12.2 tons per acre.

A soil covered with its natural mantle of climax vegetation represents conditions most favorable to maximum absorption of rainfall and maximum erosion control.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE MONTANA STATION. Montana Sta. Rpt. 1935, pp. 28, 29, 47, 48, figs. 2. Progress results are briefly presented of investigations on the development of water reservoirs on the range and of a homemade double intake centrifugal pump for irrigation.

CONSERVATION OF LAND AND WATER RESOURCES OF NEBRASKA, *G. E. Condra.* Nebr. Univ., Conserv. and Survey Div., Conserv. Dept. Bul. 14 (1936), pp. 46, figs. 8. This is a general discussion.

THE CARE AND CLEANING OF MILKING MACHINES, *A. Hay.* Rubber Growers' Assoc., Rubber and Agr. Ser. Bul. 4, (1936), pp. [1] + 16, figs. 13. Practical information is given on the subject.

THE USES OF RUBBER IN COMMERCIAL HORTICULTURE, *A. Hay and D. F. C. Vosper.* Rubber Growers' Assoc., Rubber and Agr. Ser. Bul. 6 (1937), pp. [1] + 16, figs. 18. These uses include pneumatic tires for garden tractors; rubber-jointed tracks for track-type tractors; and rubber tires for spraying equipment, wheelbarrows, and planting and harvesting equipment.

DISTRIBUTION AND COSTS OF STEAM, ELECTRICAL POWER, AND LABOR IN REPRESENTATIVE IDAHO CREAMERIES, *J. B. Rodgers, D. R. Theophilus, H. Beresford, and J. L. Barnhart.* Idaho Sta. Res. Bul. 12 (1936), pp. 35, figs. 8. The results of a cooperative investigation are presented, the purpose of which was to determine the distribution and costs of steam, electrical power, and labor in representative Idaho creameries on the basis of equipment and costs per unit of each product processed. The study was conducted during the months of June, July, and August, one full month being spent in each creamery.

The boiler capacity at two creameries was 620 and 675 boiler horsepower, and the boiler efficiency averaged 74.8 per cent. The cost of generating steam averaged 33 cents per 1,000 lb of steam where an average of 294,659 lb was generated per day. The average steam consumption of the driers was 1.42 lb per pound of milk evaporated. Steam consumption of the straightaway can washer was 2.9 lb per can as compared with 2.2, 1.62, and 1.42 for the rotary washers.

The boiler horsepower required for the operation of the 720-can capacity straightaway can washer was 36.8 as compared with 11.96, 14.79, and 16.10 for the 360-can capacity rotary can washers. The average quantity of steam required to pasteurize 100 lb of cream was 8.84 lb. The driers used 65 and 80 per cent of the total steam generated at two creameries. The direct method of preheating milk for the driers required less steam than indirect heating and decreased the capacity of driers as the milk was diluted by the amount of steam condensed. Average steam used per 1,000 lb of milk and cream received was 1,792.5 lb, or a cost of 59.1 cents.

Electrical power peaks can be eliminated by staggering power operations. A synchronous motor correctly operated will raise the plant power factor and lower power costs. A maximum demand limiting devise aids in lowering power costs. Some pasteurizing vats were found to be overmotored. Churn motors operate under various degrees of load during a churning cycle, ranging from negative loads to overloads. Churns operated at rated capacity require less power per 100 lb of butter churned than when operated below rated capacity. The long-barrel, small-diameter churn used less power per 100 lb of butter than the short-barrel, large-diameter type of churn. The electrical energy required to churn fresh cream was 23.1 per cent greater than was required to churn aged cream. Only one-half as much power was required to drive the drier rolls for buttermilk as was required for skim milk. The straightaway can washer used 1.83 kwh per 100 cans as compared with 0.93, 1.31, and 0.91 kwh for the rotary washers. The average energy consumption per 1,000 lb of milk and cream received was 10.38 kwh when the average daily quantity received was 174,900 lb. The average energy cost per kilowatt-hour was 1.46 cents when an average of 51,477 kwh per month was used.

Steam, electricity, and labor averaged 28.35, 13.45, and 58.20 per cent, respectively, of the total energy cost of manufacturing butter and 78.55, 9.15, and 12.30 per cent, respectively, of the total energy cost of manufacturing milk powder. Labor represented 70.9 and 68.84 per cent, respectively, of the total energy cost of manufacturing ice cream and popsicles. The cost of electrical energy for manufacturing ice cream and popsicles averaged 29.95 per cent of the total cost. The average total cost of steam, electricity, and labor used in manufacuring buttter was 55.95 cents per 100 lb of butter, and that used in manufacturing milk powder was 81.52 cents per 100 lb of powder. The steam, electricity, and labor cost for manufacturing 1 gal of ice cream was 12.72 cents, and that for manufacturing 1 doz popsicles was 32.18 cents.

LOG RULES, TAPER TABLES, AND VOLUME TABLES FOR USE IN THE SOUTH, *F. J. Lemieux* (Jour. Forestry, 34 (1936), No. 11, pp. 970-974). The author presents and discusses the functioning of tables developed and adapted for use in southern forests and which, over a period of 16 yr of appraisal work, have proved useful in various section of the South. *(Continued on page 478)*

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METHODS OF HEDGE AND TREE-STUMP CLEARING, *T. Swarbrick.* [Gt. Brit.] Min. Agr. and Fisheries Bul. 101 (1936), pp. V + 16, figs. 11. This is a brief account of methods of hedge and stump clearing now in use in England. They include hand-operated and power pullers, explosives, and chemicals.

PLANTING OF WOODY PLANTS FOR EROSION CONTROL, *G. W. Hood.* U. S. Dept. Agr., Soil Conserv. Serv. Bul. 1, rev. (1936), pp. [1] + 38, pl. 1, figs. 16. This is an elementary and general discussion of the subject.

A WEED ERADICATION PROGRAM. Reclam. Era [U. S.], 27 (1937), No. 2, pp. 36, 37, figs. 2. In this brief article a single blade weed eradicator is described and diagrammatically illustrated, and brief specifications are given.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE SOUTH DAKOTA STATION, *R. L. Patty.* South Dakota Sta. Rpt. 1936, pp. 5-8. Progress results are briefly presented of investigations on field machinery hitches for tractors and large horse teams, rammed earth for farm building walls, corn harvesting machinery, protective coverings and life of steel fence posts, and rammed earth walls in poultry house construction.

GROUNDWATER LAW IN ARIZONA AND NEIGHBORING STATES, *G. E. P. Smith.* Arizona Sta. Tech. Bul. 65 (1936), pp. 43-91, figs. 5. This bulletin discusses ground water law in Arizona and neighboring states to aid in the proper consideration of any further litigation, to stimulate widespread discussion to precede any new legislation, and to give ground water users an understanding of the nature of water rights.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE FLORIDA STATION, *B. S. Clayton and A. Daane.* Florida Sta. Rpt. 1936, pp. 125-127. The progress results are briefly presented of a cooperative study with the USDA Bureau of Agricultural Engineering relating to the effect of water control on peat and muck soils.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE WASHINGTON STATION, *G. M. Horner and P. C. McGrew.* Washington Sta. Bul. 342 (1936), pp. 69-71. Progress results are briefly reported of investigations on effect of plant cover on runoff and erosion, movement and balance of soil moisture, tillage and cultivation practices for erosion control, cropping practices in relation to erosion control, terracing, gully control, tree planting for erosion control, and wind erosion.

TESTS OF CHICK BROODERS, *E. T. Swink,* Virginia Sta. Bul. 306 (1936), pp. 16, figs. 9. This bulletin reports the results of a series of tests on several types of brooders. The object was to determine (1) the fuel consumption of each type of brooder as a basis of comparing operating costs under identical brooding conditions, (2) a comparison of the brooding results obtained by these methods of brooding, and (3) the most satisfactory and practical type of electric brooder for use on Virginia farms.

Six brooder houses approximately 9 by 12 ft in dimensions were used in the tests. They were not insulated and had single thickness tongue and grooved floors. Their design was similar to the standard VPI portable colony houses, the main difference being that the doors to three of the houses were located in the front center instead of at the ends of the building. Ventilators were arranged so that the same principle of ventilation was used in all houses. The houses were grouped on the southeastern slope of a hill so that a uniform exposure was assured.

The following brooders were selected: (1) Standard 56-in electric with natural ventilation, (2) standard 56-in electric with forced ventilation unit, (3) home-made electric using a 52-in metal hover from a discarded fuel-type brooder, (4) home-made electric 72 by 30 by 9.5 in constructed of wood, (5) commercial coal brooder, (6) commercial kerosene brooder, and (7) commercial wood stove. All electric brooders used in the test had "black heat" or low temperature heating elements.

Although it is certainly desirable to maintain as uniform brooding temperatures as possible under the hover or canopy, the results of these tests show that probably too much stress has been placed on this point. Good brooding results may be had from either electric, kerosene, coal, or wood brooders when properly operated.

Where the labor item will not be considered in the cost of operating brooders, the most economical brooder to use will depend on the comparative cost of fuels at the place where the brooder is to be operated. The ventilation of the brooder and brooder house is just as important as the maintenance of a uniform brooding temperature. This is true in the fuel-heated house because the open fire removed large quantities of oxygen from the air and this must be replenished. In the electric brooder house no effort is made to heat the room and, therefore, good ventilation is necessary to assist in keeping the litter in good condition.

The operating results of the converted electric brooder indicate that there is nothing to be gained by trying to convert old hovers into electric brooders. The increased current consumption soon makes up the difference between the cost of rebuilding the brooder and the price of a proved electric brooder.

The home-made electric brooder, a plan of which is included in this report, gave good brooding results with an average current consumption. The tests indicate that the principle on which this brooder operates is a good one. The design is such that good ventilation is assured and the distribution of heat under the brooder is uniform. The total cost of a brooder of this type is approximately $10, exclusive of labor.

No particular advantage could be noted in the operation of the commercial fan-type brooder over the standard commercial brooder. Although the mortality rate was slightly lower and the average weight per broiler produced was higher, these factors do not offset the increased investment and cost of operation.

During the coldest weather the floors under the litter, and especially under the hovers of the electric brooders, had a tendency to become damp. This was probably due to the prolonged damp weather and to insufficient ventilation during these periods. No ill effects on the chicks were noted as a result of this condition.

The firing of the wood and coal brooders, together with the handling of fuel and ashes, required considerably more time and labor than that for other brooders. The kerosene brooder was second in labor requirements. It was necessary to dismantle the kerosene brooder twice during each of the three trials to remove soot.

The lowest temperature during the tests was 7 F below zero, and the average outside temperature for the 10-week period was 29.7 F. This test indicates that a well-insulated electric brooder will give good brooding results in an unheated brooder house in the coldest weather that is likely to occur in Virginia.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE IOWA STATION, *J. B. Davidson, E. V. Collins, C. K. Shedd, A. A. Bryan, P. E. Brown, and H. R. Meldrum.* Iowa Sta. Rpt. 1936, pt. 2, pp. 20-24. Progress results are briefly presented of investigations of the basin method of growing corn; methods and equipment for seedbed preparation, planting, cultivating, and harvesting; and methods, equipment, and buildings for curing and storage of corn.

THE SMALL COMBINE HARVESTER THRESHER, *E. C. Sauve.* Michigan Sta. Quart. Bul., 19 (1937), No. 3, pp. 162-164, fig. 1. The results of the survey of the use of the combine harvester-thresher by Michigan farmers are briefly presented, indicating that 5 or 6-ft combines, reasonably priced, will give satisfaction and economy.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE OKLAHOMA STATION. Oklahoma Sta. [Bien.] Rpt. 1935-36, pp. 175, 176. Progress results are briefly presented of investigations on the electric fence as a control for livestock.

EARLY EROSION-CONTROL PRACTICES IN VIRGINIA, *A. R. Hall.* U. S. Dept. Agr., Misc. Pub. 256 (1937), pp. 31, figs. 4. This is a popular historical document, which is accompanied by a bibliography of 93 references to literature bearing on the subject.

AGRICULTURAL ENGINEERING INVESTIGATIONS BY THE UTAH STATION. Utah Sta. Bul. 276 (1936), pp. 49-54, figs. 3. Progress results are briefly presented of investigations on drainage and irrigation conditions in Millard County, snow surveys, effect of deep cultivation on water penetration, irrigation efficiency, and fundamental principles of hydromechanics.

SAFETY IN THE HANDLING AND USE OF EXPLOSIVES. U. S. Dept. Agr., Soil Conserv. Serv., 1936, R5-Ms-5, pp. [5] + 27, figs. 4. Popular information on the subject is presented.

SOIL CONSERVATION PRACTICES, *R. E. Uhland.* U. S. Dept. Agr., Soil Conserv. Serv., 1936, pp. [2] + 179, figs. 85. The purpose of this handbook is to bring together in concise form some of the latest technical information on erosion control. It contains sections on land inventory and utilization, cropping practices (agronomy), forestry practices, wildlife conservation, and engineering methods. *(Continued on page 480)*

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WATER AND SEWAGE RESEARCH AT THE NEW JERSEY STATIONS. New Jersey Stas. Rpt. 1936, pp. 105-110. Progress results are briefly presented of studies on the activated sludge process, chemical coagulation of sewage, electrodialysis of trade wastes, odor control of sewage, pathogenic organisms in surface water and sewage, industrial waste treatment, chlorination of sewage and activated sludge, and garbage disposal in sewage.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS OPEN

DESIGNERS and layout men familiar with grain, hay, and corn harvesting machinery wanted by a leading manufacturer of farm equipment. Must be high-grade men. PO-115

DESIGNING ENGINEER wanted by a farm implement manufacturer. Experience with plows, seeders, and general tillage tools is essential. Apply in care of ASAE, St. Joseph, Mich. PO-116

ASSISTANT EXTENSION ENGINEER wanted by middle western state to develop rural electrification work. Beginning salary of approximately $1800 per annum. PO-118

AGRICULTURAL ENGINEER wanted as instructor in farm mechanics and farm shop, including wood work and farm machinery repair. Applicants should write direct to A. A. Stone. New York State Institute of Applied Agriculture, Farmingdale, L. I., N. Y.

AGRICULTURAL ENGINEER, who has specialized in agricultural and irrigation machinery, is wanted by the Agricultural and Industrial Bank, Baghdad, Iraq. He must have the equivalent of a bachelor's degree, from seven to ten years' practical experience, be well qualified to undertake repairs of all kinds of agricultural machinery for irrigation, plowing, threshing, and reaping, and have a sound knowledge of the use of agricultural machinery in practical farming. It is desired to employ him as head of the mechanical department in this bank or in some similar capacity, and he will be required to advise farmers on the use of agricultural machinery and train Iraqi workmen in their operation. The period of the agreement will be for three years and the salary will be from 60 to 90 dinars ($290.00 to $340.00) per month, according to qualifications. Applicant should write direct to A. J. Chalalei, Ministry of Education, Baghdad, Iraq.

POSITIONS WANTED

AGRICULTURAL ENGINEER graduate of Kansas State College in the four-year course in agricultural engineering. Experience includes two years as camp engineer on erosion control work and two years in college extension in county agent and extension engineering work. Desires connection in college or industrial extension, farm machinery or farm management. Married. Age 24. PW-280

AGRICULTURAL ENGINEER with a farm background desires employment in the field of soil erosion control, irrigation, or farm machinery. Educational or demonstrational work preferred. Holds a degree in agricultural engineering from a middle western university. Has one year's experience in highway engineering and three year's experience as a CCC camp engineer for the Soil Conservation Service. Has had considerable experience in contacting and working with farmers. Married. Age 28. PW-282

AGRICULTURAL ENGINEER, graduate of the A. & M. College of Texas, desires employment in the field of soil conservation Has farm background, has been employed by a county agent, and employed since June 1936 by the International Harvester Company of Houston, Texas. Age 26. Single. PW-283

AGRICULTURAL ENGINEER with B.S. degree in electrical engineering, M.S. degree in agricultural engineering from the State College of Washington, with one year's experience in the USDA agricultural extension service and 2½ years' experience in rural electrification under J. C. Scott, agricultural engineer of the Puget Sound Power and Light Co., desires position in agricultural engineering in the rural electrification field or research and teaching position with a college or experiment station. Now employed, age 27. Working toward engineering degree in June 1938. PW-284